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REFLECTIONS ON THE HOMESTEAD STRIKE.

By Julian Hawthorne.

THE recent disturbances at Homestead, while not differing in principle from other labor outbreaks, were marked by especial bitterness on the men's part, and by determination on the part of the firm; and several dramatic episodes have drawn the attention of the country to the struggle, and made it valuable as an object-lesson. We were confronted with a spectacle but nominally distinguishable from anarchy. Indeed avowed anarchy took a hand in the battle, in the attack on one of the firm's managers. In the daily press the series of events has been copiously though not often judiciously depicted and commented on; but the New York *Sun*, ignoring partisan politics and the temptations of an unworthy popularity, published a succession of remarkable editorials, stating the true issues forcibly and unflinchingly.

For my own part, I think the action of the discharged employés has been indefensible from the start, and that the firm, save on one occasion, has been in the right. I shall briefly outline what happened, and then consider what can be done to prevent the recurrence of such outbreaks hereafter.

There were three points of dispute between the men and the firm: (1) as to the minimum figures for a "sliding scale" of wages; (2) as to the time at which the yearly agreement regarding wages should be made; and (3) as to the amount of reduction in the pay of a certain class of Homestead laborers,—325 in number, out of a total of between 8000 and 9000 employés. Whether or not Hugh O'Donnell's unsupported assertion be true, that this reduction was to have been followed by similar reductions "all along the

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line," the fact remains, as stated by the New York *Times*, that—allowing for the claims of humanity—the legitimate rate of wages in any occupation *must* depend upon the supply of the particular kind of labor required in relation to the demand therefor. No basis of agreement was reached between the men and the firm, and the former were thereupon discharged, and the firm announced its determination to employ no more "Union" laborers. Pending the hiring of other laborers, the works were shut down. The town of Homestead consists mainly of dwellings hitherto occupied by the firm's men, but, of course, no more belonging to them after discharge than to me or to the reader. Nevertheless these unauthorized persons now seized upon both the town and the mills, and declared that, if they were not to work there at their own terms, no one else should, and that whoever attempted to do so risked his life.

We may observe here that it has been contended that the fact that Mr. Carnegie, the owner of Homestead, once said in certain articles in the *Forum* things inconsistent with the present attitude of the firm renders that attitude legally and economically untenable. He made five statements, one of which was a truism, while the other four were more or less foolish. The truism was that strikes and lockouts, like the duello, are a resort to force, which, whatever the issue in specific cases, establish no economic truth. He then asked consideration for the unwritten law, "Thou shalt not covet thy neighbor's job"; declared that non-union laborers were generally to be regarded with disfavor, and added that "to expect that one dependent on his wages for the necessaries of life shall stand peaceably by and see a new man employed in his stead was to expect much"; and finally, he agreed with Martin Irons, a labor agitator, that a little courtesy on the part of employers towards labor deputations would often avert a strike. In other words, a soft answer would not only turn away wrath, but would enable a laborer to live on wages which had a moment before been insufficient for that purpose! Now, it is doubtless annoying to Mr. Carnegie to be thus arraigned against himself, but neither his feelings nor his sayings are any more decisive of the question at issue than are anybody else's. The thing to be determined is the abstract or algebraic value of the situation, and thence to devise an equation for settling such differences henceforward.

The firm were in the position of a householder whose discharged servants bar him out of his own house, and will only admit him on

his promise to reëmploy them on their own terms and to forever renounce all servants but them. The firm duly appealed for redress to the sheriff, who, on being defied by the rebels, invoked the aid of the Government. While the latter was hesitating whether or not to send troops, the firm committed their single error; they hired the "Pinkerton Guards" to get possession of the mills and to safeguard their new laborers. But let it be noted that the strikers had not, under the circumstances, the remotest justification in resisting the Pinkertons. Nevertheless, under our theory of Government, the laws are an absolute protection to the individual in the maintenance of his rights, and no extraneous aids are necessary. The Pinkertons were resisted, and bloodshed and outrage followed. The killing of the Pinkertons was murder, because they represented the lawful owners of the property. The strikers were now like burglars who fortify a man's house against him and shoot him down on his attempt to enter. Troops, under General Snowden, arrived, and order was forcibly restored, though only so long as the troops should remain. At this juncture, Mr. Frick, the local manager of the business, was shot and stabbed by an avowed Anarchist, not without the explicit approval of individual strikers and of one member of the militia. General Snowden took a gloomy view of the situation, believing we were on the brink of a war with the commune.

Formerly employers were masters and laborers slaves. Now men may work or not, as they choose. Natural law, however, still makes work obligatory. Except capital be invested for productive purposes, the capitalist as well as the laborer must starve. Wealth is a fund acquired by help of labor in industries organized by capitalists. Not the capitalist, but the necessity of self-support forces the laborer into the factories. They have neither means nor ability to organize industries for themselves. Either party may terminate the connection, and the laborer may also use argument and persuasion, not amounting to force, to deter others from taking his place. But the right of employers to conduct their business in their own way, and of "scabs" to replace "Union" men, is sacred, and to be upheld, at need, by the whole force of the State. The "rights" arrogated by labor unions can be conceded only in so far as they do not clash with the fundamental rights of the individual. On no plea may ex-employés take possession of their late employer's works. If such a thing as human property in anything exists, then the Carnegies own Homestead

and the only alternative of supporting them in that ownership is the acceptance of Anarchy.

Neither Free Trade nor Protection can claim to palliate these evils, since England, the home of Free Trade, is no less cursed with labor troubles than are the protectionist countries of the continent of Europe, and the United States. The stock remedy in all cases is arbitration. Mr. Carnegie favors it in his *Forum* articles, though in the present conflict the firm very properly declined it. A man whose pockets have been rifled might as reasonably be asked to arbitrate the question whether their contents be restored to him or not. Sporadic cases may arise when arbitration may find a *modus vivendi* which had escaped the notice of the disputants, but disputes between labor and capital are not like quarrels between nations. They involve purely economic questions, and, since the employers are controlled by their knowledge of what they can afford to pay labor, while the men are actuated by a desire to get more money or shorter hours, it naturally follows that, unless the employers are deliberately misrepresenting their case, the decision must either be in their favor, or they must abandon their industry. Should the arbitrators' award be nevertheless made legally obligatory, State regulation of wages and industries must ensue, leading to Bellamyism or State Socialism. The alternative is to keep a standing army to terrorize our vast working population into submission; which, in a "free" country, would truly be a *reductio ad absurdum!*

Every reader of this magazine knows that the impartial distribution of capital, in the form of money, would presently be followed by universal starvation. All there was to eat, drink, and put on in the world having been exchanged for money, and consumed, nothing but apples and fig-leaves would be left. Nothing could meanwhile have been manufactured to replace what was consumed, the former laborers lacking the organizing ability, and everybody lacking the capital. The power to make a living is cut off at both ends.

It is not less well known that, *cæteris paribus*, the public favors the striker as against the capitalist. Such adages as "He is rich and can afford to pay," "The world owes every man a living," "Enough to eat and drink without having to work yourself to death to get it"—represent the good-natured, irresponsible sentiment of the public in these matters. And although, as we have seen, the poor man cannot be relieved at the direct expense of the rich man, yet there is a basis of truth in the public's uninstructed and instinctive judgment.

The land is the people's. Rightful ownership in land can only exist if, and while, the owner *uses it for productive purposes.* Argument in support of this truth need not be arrayed here. Of late years it has been amply and eloquently vindicated. The time is at hand when it must perforce be acted on. The present license in land speculation, on the part of both individuals and corporations, should be summarily terminated by laws restrictive and punitive. Such speculation is not a legitimate use of capital. It is hostile to the common weal. Land is juggled from hand to hand, each transfer carrying a profit until the last purchaser of them all, and the only one who means to put his purchase to its proper use, is compelled to pay the whole sum wrongfully extorted by his predecessors. He is actually fined for conferring a signal benefit on the community,—for supporting himself and producing the necessaries of life for others. The land-speculator produces nothing except the distress of better citizens than he. It is speculation in vacant and unused land—the natural opportunities for labor—that has finally wasted our magnificent public domain ; that holds millions of acres of farming lands idle " waiting for a rise " ; that locks in the grasp of monopoly limitless treasures of natural wealth in our mines ; and that disfigures every city with numberless vacant building sites securely held by people who make a business of investing or dealing in "unimproved real estate." What wonder that farms are eaten up by mortgages and finally abandoned in despair, and that our cities, trades, and manufactures are ruinously congested ! What wonder that wages are low and labor a drug in the market !

The remedy for " Homestead," then, and solution of all else insoluble disagreements between Labor and Capital, is to give the underpaid laborer free recourse to the unused land. The public domain of the United States is ample to afford relief to our laboring population for generations to come. But that magnificent domain has been blighted and sterilized by inadequate legislation and selfish chicanery. It is no new idea, indeed, that occupancy and use should be the basis of land legislation. But the laws framed for that end are, in the first place, not thoroughgoing enough, and in the second place, such as they are, they are too easily evaded,—their letter observed, while their spirit is violated. More stringent laws, and more searching enforcement of them, are needed. Not a few statesmen and scholars, who think straight and see clear, have demanded it. Even in the English Parliament, a bill recently

introduced, constraining the landlords of Great Britain to sell vacant and unused land in small lots to purchasers who guaranteed to work it,—the price to be fixed by juries under the supervision of borough officers,—came within fifty votes of being made law. The drift of the times is in this direction, and the spirit of the age demands it.

In the disputes between Labor and Capital, while the latter, as we have seen, is economically in the right, the former is only technically in the wrong. Laborers have the inalienable right to be supported by their labor, and it is the deficiency of our Government administration that disables them from availing themselves of the great natural outlet afforded by this continent. But champions can be appointed and measures can be carried by the exertion of the popular will through the suffrage, and the plank in the platform of the labor party which looks towards the relinquishment of the land to its proper owners should be so revised and strengthened as to fully and finally secure that righteous and indispensable result. Every farmer should be empowered to get and hold unoccupied and unused land without price. All land and all mining properties for speculative purposes should be thrown open and made over to *bona fide* occupants and users. Then the man of Homestead, or whosoever else cares to be his own master, with wages dependent not on the necessary profits of employers, or the competition of paupers from European slums, or the activity of the market, but solely on his own intelligent industry, can, instead of shooting down "Pinkertons," or beating non-union men to death, or blindly obeying the self-interested dictates of ignorant or dishonest "leaders," turn his back on mills and factories, and go to the free earth and the open sky. A generation hence we shall look back in wonder at the strange enchantment which so long imposed lethargy and bondage upon limbs and faculties meant to be active and free. In this enlightened age and on this broad continent, with its immeasurable stores of natural wealth and its absolutely unlimited opportunities for unemployed labor, the industrial congestion and disorder of these times is a disgrace to common intelligence. The sole disturbing element is a surplus of unemployed labor, and the sole remedy necessary is to throw open the limitless opportunities for productive industry which nature affords and which nature alone can provide.

TALL OFFICE BUILDINGS—PAST AND FUTURE.

By Dankmar Adler.

THE modern tall office building, or "sky-scraper," can scarcely be said to have a past, but its present is in the highest degree aggressive; what its future will be depends upon the success with which the lessons of its existence and use in the present shall be studied and applied.

The high-speed passenger elevator was the chief prerequisite for the development of this type of buildings. It is scarcely twenty years since the mechanism of the elevator became sufficiently developed to make it a reliable means of communication between the lower and upper floors of buildings. The "water balance" elevators in use in the early "seventies," although in many respects as efficient as the best of the hydraulic elevators of to-day, moved with too high a speed for the comfort of passengers. To all intents and purposes, the modern high-speed elevator is not more than ten years old, and, until popular confidence in it had been established, there could be but little utilization of space above the third stories of buildings. Although buildings five or six stories in height were constructed, their upper stories had little actual commercial value. Even after the example of the *Tribune* building, the Boreel building, the Western Union building, and one or two others in New York, and of the Central Music Hall block, of Chicago, had demonstrated that the equipment of a building with several elevators would assure a constant and steady service and avert the necessity of resorting to the stairs as a means of communication, several years elapsed before the renting public was ready to avail itself of the superior advantages offered by the higher and better-equipped buildings.

Another cause which served to limit the height of buildings within a hundred feet was the high price of structural iron. The Bessemer process was in its infancy and had not been applied to the manufacture of structural material. There was also a fear as to the safety of so-called fire-proof buildings, based upon the experience of London, which had demonstrated the inability of unprotected structural iron to resist fire. Efficient means for the

protection of iron pillars and beams against fire did not become known to the building public until late in the seventies. Even to-day architects and owners of buildings in New York and other Eastern cities do not seem generally to recognize how important it is that exposed structural iron and steel should be protected with incombustible non-conducting coverings, and their work is a standing argument against the erection of high buildings.

But when it had once been demonstrated that an incombustible and fire-resisting tall building could be erected, and that it could be equipped with a sufficient number of elevators to carry occupants and their customers to great heights with less discomfort and in less time than that required for walking up-stairs to the second or third story; when experience had proved that the offices in the upper stories of these buildings were brighter and freer from dust and noise than the offices on the lower floors,—a demand arose at once for business quarters high in the air. The demand was no sooner felt and expressed than the owners of real estate in the business districts of our great cities vied with each other in efforts to satisfy it. This was particularly so in Chicago, notwithstanding the obstacles to the erection of high buildings due to the treacherous soil underlying its business districts. Chicago has become known as essentially a city of "sky-scrapers," and other cities, with greater or less success, have followed her example.

It is the purpose of this paper to study the tall office building, to enumerate and compare its qualities good and bad, and to determine whether or not it is merely an ephemeral and erratic manifestation of human ingenuity. If good reasons for its continuance can be found, a study of its actualities and possibilities from the sociological, the structural, and the artistic standpoints will lead to an effort for the determination of the lines upon which its further development should proceed.

In a utilitarian age like ours it is safe to assume that the real-estate owner and the investor in buildings will continue to erect the class of buildings from which the greatest possible revenue can be obtained with the least possible outlay, taking into account not merely first cost of construction but also cost of maintenance, tendency to depreciation, etc. These last-mentioned considerations will be most carefully considered in connection with the largest investments. Hence the great sums expended and the great risks assumed in the erection of tall buildings have induced

a degree of care in the determination of design, materials, processes, and workmanship of construction which have made the "sky-scrapers" the embodiment of the highest and best development of the science and art of building in our times. As compared with smaller and lower buildings, they are stronger and sounder, and more capable of resisting the destructive agencies of fire, time, and use.

The owners of a building costing a million dollars or more must fortify themselves at every point against the possibility of total failure of their enterprise. The importance of securing for their structure a large number of tenants is so great, the loss arising from failure to secure a sufficient number is so disastrous, that they find themselves compelled not only to so conduct the construction of their building in every detail that it invites confidence of the public in its structural stability, but to make its equipment so thorough and complete and its administration so efficient as to give tenants the assurance that their premises will be well lighted, well aired, clean, comfortable, and cheerful, and at all reasonable times easy of access. Consequently the buildings of the "sky-scraper" type find tenants at higher rentals than buildings of the older type.

While it might be theorized that those investing smaller sums in smaller buildings would, from motives of self-interest, exercise the same care in their design, construction, and equipment, and would make the same efforts for securing the comfort of their tenants, we are in fact confronted by the condition of the average small business building, which is anything but inviting to its occupants. And we have not far to look for a theory to explain this condition: The purpose of erecting buildings other than those required for the shelter of their owners is specifically that of making investments for profit. Within certain limits the proportionate cost of high-grade, first-class modern buildings diminishes with their size. To erect a small fire-proof building, and to equip it with boilers, engines, dynamos, pumps, tanks, elevators, and so forth, involves an outlay relatively greater than that required for a larger building. Again, the expense of maintaining buildings, within certain limits, diminishes relatively as the size of the building increases; engineers, firemen, elevator-conductors, elevator-starters, janitors, and watchmen are required relatively in larger numbers for a small than for a large building. Hence, if the owner of a small building wishes to equip it with the same com-

pleteness as does his neighbor who owns a very large building; if he desires to compete with this neighbor in the thoroughness of the service,—he will be at a disadvantage, even supposing that he is satisfied with a smaller margin of profit.

People flock to large cities because the facilities for carrying on business there to be found are better than those in the smaller towns and cities. The large business building, of great floor area and many floors, is in a certain sense an epitome of city life and business. Business to-day is done under very high pressure. It is the aim of every one to accomplish as much as possible in the shortest possible time. If A, B, and C are apt to have business relations with each other or with each other's customers and clients, they find it profitable to establish their offices in the same building, so as to make it possible for themselves, for their employés, their customers and clients, to transact business with one another without being compelled to step into the street. And if the building is so large that not only A, B, C, and D, but also E, F, G, and H can be accorded the same accommodation, its owner will obtain from them in the form of increased rentals a fair proportion of the value of the money, time, and wear and tear of nerve saved. Again, the owner having secured as tenants A, B, C, D, etc., highly respected and well known in the business and professional world, each having a large clientele, the desire to be near these persons, to have one's name on directory and door-sign read by their many clients and customers, draws other tenants into the building. The demand for space and the price of rentals increase with the traffic on any street, and the same cause produces the same effect within the walls of a large business building.

Experience shows that a classification works itself out among the occupants of these large buildings; that each building is filled with persons of correlative business and pursuits; that it becomes much easier to transact business and to accomplish results by reason of these classifications and juxtapositions under the same roof. It is possible to transact one's business sometimes with dozens of people within the walls and under the roof of one building, or for dozens of firms to transact their business with each other without going outside the door of one great office building. With the tendency of the times to shorter working hours, to increased number of holidays, and longer vacations, everything which enables people to transact business in less time is conducive to general advancement along these lines.

Those who endeavor to look into the future often ask what will be the fate of the "sky-scraper" when all the streets of our cities are lined with structures of that type? Will not then the congestion of traffic in our streets be such as to make it impossible to reach these hives of human industry? Will not the shadows thrown into the streets be such as to render the rooms in all but the top stories too dark for use? Will not our streets then become analogous to those of the medieval cities, and will not our cities, filled with structures of this type, become as unwholesome as were the walled towns of the middle ages?

Let us assume that a thousand people can transact their business within the walls of a given building five stories high, and three thousand within the walls of a building fifteen stories high. If we have three five-story buildings, all communication as between their respective occupants will be on the streets and will tend to congest street traffic. If, however, these three buildings are concentrated in one, the inter-communication of these three thousand people will not touch the street at all, but will be within the limits of the one building, thus relieving the streets of so much traffic and diminishing the danger of congestion. As regards the morning and evening hours—the times of going to and from business—comparing the inmates of say fifty five-story buildings with the same population condensed into fifteen buildings of equal ground area but greater height, while the total number of persons transported from the residence to the business district by public conveyances will be the same in both cases, yet the average distance traveled by each person between home and office will be much less if the people are concentrated in fifteen tall buildings than if scattered among fifty lower buildings, thus diminishing the stress upon the street railroads.

Turning now to the anticipation that the lining of our streets with very tall buildings may give us a repetition on large scale of the evils in the street architecture of the walled cities of the middle ages, it may be said that in our Western cities the streets are so wide that there is no reasonable probability that the proportion of width of street to height of buildings will ever become as unfavorable as in the medieval cities. It is true that if both sides of all streets in the business districts of our cities were lined with "sky-scrapers," the lower stories would be at a disadvantage as regards light, but the upper stories would still hold the advantage of being above the dust and noise of the

streets, and the advantages of superior construction and equipment and concentration of business within the walls of individual buildings will always remain. But, as I shall endeavor to demonstrate in another article, it is possible to so regulate the rights and privileges of the property-owner in connection with the erection of high buildings as to eliminate the evils above mentioned.

I have before referred to the prevailing tendency to shorter working hours, more holidays, and longer vacations. Everything, therefore, which shortens the time required for reaching one's place of business from one's home, everything which saves steps, everything which saves time in transit between places of business during business hours, is in the line of making it possible to accomplish during a short day and in a smaller number of days the work of business men and professional men and their employés.

The "sky-scraper," therefore, is an institution whose effects upon the affairs of life are altogether on the lines of the demands of the American worker. So long as he will continue to transact his business with a rush, and to separate strictly the times and places for business from the times and places for recreation and pleasure, the "sky-scraper" will aid him in achieving his ends. Even if the American man of business should adopt customs more akin to those of France and of the "gemuethlich" portions of Germany where recreation and business slip into one another; where large parts of each business day are spent at meals and in coffee houses; where the coffee-house becomes in a certain sense a business exchange,—I can see how the occupants of large buildings could find establishments like the Lawyers' Club in the Equitable building in New York, or like the restaurant on the top floor of the Pullman building and the roof-garden on the Masonic Temple at Chicago, most agreeable places of reunion, and substitutes for the coffee-house or other places of resort in Paris or Vienna.

The tendency of mankind to compress itself within the confines of large cities may be an unwholesome tendency and one fraught with danger to the human race, but, if so, the race as a whole has failed to perceive its unwholesomeness, or to note that its condition is other than agreeable. On the other hand, the desire to live as part of a large and closely-packed community has become constantly more widespread and more intense. Notwithstanding the many conditions tending to render life in cities disagreeable and unpleasant, it seems useless for humanitarians and philosophers to argue against a tendency so old, so strong, and so constant.

If we compare the great city of low and small buildings with that of large and tall structures, we may be able to form conclusions as to which is the more wholesome, the more pleasant, the more conducive to the comfort and well-being of its inhabitants. Those who have had occasion to transact business in London, where the average height of buildings is scarcely four stories, will remember how much time is consumed in going from place to place, how far apart the various persons with whom one may have to do business are apt to be located, and how, when one has reached the place of business sought for and has found its occupant, this process is apt to involve the climbing of dark, steep, and crooked stairs, and is almost sure to lead into dark, dingy, dusty, and unwholesome quarters. New York is somewhat better, although even there the distances between the offices of business men are often excessively great and many of the offices are in small, dark, ill-ventilated, ill-smelling, antiquated buildings with a mere apology for elevator service, and forming a most striking contrast with the rooms in the newer and better structures. In Chicago the erection of many "sky-scrapers" has permitted the concentration of business in so small a space that it has become as easy to transact business with twenty different persons in twenty different offices in one day as it is in London to do so with three or in New York with ten. It is true that the volume of business transacted in London and New York is much greater than that of Chicago, and that therefore the number of business men is greater, so that under all circumstances it must take more time to see a given number of people in London or New York than in Chicago. But the difference in the time required to overcome the greater distances is entirely disproportionate to the differences in population.

While this comparison seems to relate almost entirely to those who transact their business and earn their bread in offices, who in numbers form but a small portion of even an urban community, it should be remembered that the professional men and the managers of great business and industrial enterprises are chief among the tenants of offices, and that it cannot be denied that these contribute more largely to the shaping of affairs and events than do any other equal number of their contemporaries. Therefore, if their work is done amidst more wholesome conditions and surroundings; if their time is saved; if their nerve force is conserved by reason of improvements in their places of business,—great benefit will accrue to mankind at large.

It may be further said that the "sky-scraper" need not necessarily be a business building. If the concentration of a large number of business tenants in one tall building upon one piece of ground makes it possible to give them at the same rentals better accommodations than could be obtained in smaller structures of less altitude, why should not the same principle be applied, with intelligent modifications, to lodging-rooms, tenements, and apartments of all kinds? As soon as the conditions of life in any city are such that each family can no longer occupy a separate house; as soon as individuals and families must herd with each other in tenement or apartment-houses,—cannot these conditions be made more favorable for occupants and for owners of buildings, if apartment houses of high altitude, of fire- proof and vermin-proof construction, with large internal and external light-courts, are built to take the place of the ordinary tenement-house?

An illustration of the possible good effects which might accrue from the introduction of the "sky-scraper" on a large scale is found in London, where, among other things, it might accomplish the elimination, or at least the amelioration, of the London fog. It is probable that there are in London not less than twenty-five thousand business offices contained in two thousand or more low, small buildings, almost every room with its chimney and its open fire-place sending forth smoke. If these twenty-five thousand offices were concentrated in say one hundred tall structures of the Chicago type, provided with a heating- and power-plant of the best design, substituting a hundred large smokeless stacks for the thousands of smoking ones now in use, the furnaces served by these hundred stacks burning fuel completely as compared with the combustion characteristic of the grate arrangements of the present buildings, this alone would make a vast difference in the condition of London. An extension of this process to the "lodgings" and apartment-houses of London would accomplish still more noteworthy results. All this done, and the buildings crowded upward, the narrow and crooked streets could be widened, the distances to be traversed would be materially diminished, and the streets would become freer, sunnier, and more airy than they are to-day. While the County Council is battling for new and wider streets in London, it could accomplish its ends much more readily if, with the introduction of new streets and avenues, it were to adopt regulations tending to promote the erection of tall buildings of the Chicago type.

Following the investigation a little further and assuming that the primary cause of the advent of the "sky-scraper" was the cupidity of the real-estate owner who chose to erect a building on top of another building, and another on top of that, and so on, in order to save the cost of the acquisition of more land, it is safe to assume that his cupidity would not have been rewarded by financial success if the crowding of buildings upward into the air had not met with a response among the tenants, occupants, and frequenters of buildings. The person who erects buildings for rental is in the same condition as the manufacturer who produces or the merchant who sells commodities. If the commodities are not those which the public wants at the prices at which they are offered, they will be left on the hands of the producer or vendor.

Misuse and perversion of capital concern not merely their immediate victims but the general public. Many of the panics and crises which have distressed the people of the old and the new world were due to misapplication of capital on a large scale. The sums of money which may seek investment in American "sky-scrapers" are so vast that failure on the part of owners of buildings or designers to make these investments financially succcessful would be followed by the most serious and disastrous consequences to the entire community. It will be a matter of public policy, therefore, to give most careful study to every peculiarity and possibility of the development of these enterprises.

There is danger that, if it is once generally recognized that structures of this kind are profitable, and their erection becomes a matter of frequent occurrence, the extraordinary care used in the designing of the earlier ones will be lost sight of, and that with greater familiarity will come the carelessness so characteristic of the design and construction of less important buildings. In fact, indications of this tendency may already be noted. On the other hand, the efforts thus far made to control the erection of tall buildings by municipal authority have been one-sided, short-sighted, and chiefly prohibitive. They obstruct but do not regulate the design or methods of construction of these important structures.

In another article, more technical in character, I shall endeavor to illustrate some of the statements herein made, and to show the lines which should be followed by those who would design or own tall business buildings, and shall indicate what in my opinion should be the trend of municipal control and regulation of buildings.

ELECTRIC POWER IN MINING.

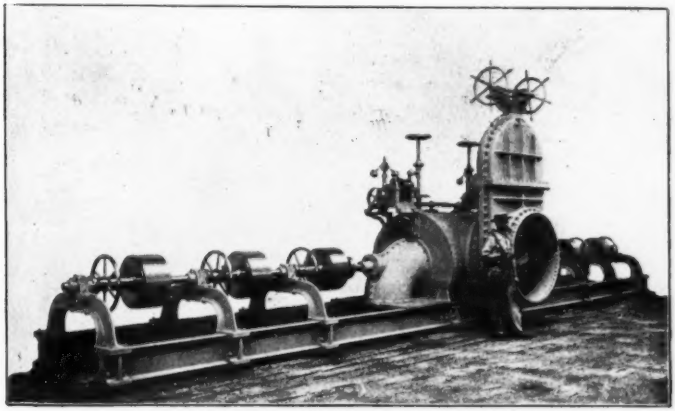
By Irving Hale.

THERE is a genuine fascination in the modern applications of electricity to the needs of business and social life,—to the transmission of messages over continents and seas by means of the telegraph, to the transference of the human voice, with all its individual peculiarities and inflection, through the telephone, and to the illumination of cities by electric currents distributed from a single station. But none of these appeal as strongly to the imagination as the transmission of power by this mysterious force. When we watch a ponderous engine, with its strong rods and cranks of steel and massive fly-wheel, anchored to a foundation of solid masonry to resist the vibrations produced by its mighty efforts, it is easy to appreciate the enormous power that is being developed ; but when we are told that all this power is required to revolve a bundle of wires in the open space between the poles of a magnet, and that in those wires nine-tenths of this mechanical energy is converted into electrical energy and passes out of the building on a few small wires which undergo no strain and give no visible evidence of the work that is being done within them, and that this electric energy can be transmitted for miles and reconverted into mechanical power, we cannot fail to be impressed with the remarkable nature of this transformation and the possibilities which it involves.

The advantages of producing power where it can be done at comparatively small expense, either with water-power or cheap coal, and transmitting it to places where water-power is not available and fuel is expensive, are so evident as to require no discussion, and it is obvious that there are few places offering better fields for such operations than the mining districts, where water-power is generally available within a few miles, but seldom at the mine or mill, and where the cost of coal is almost always great. Moreover, electricity is peculiarly adapted to underground work, where steam is objectionable on account of inconvenience of pipes, loss by condensation, and heat produced, while the transmission of power by compressed air is inconvenient, expensive, and wasteful.

Indeed, so striking are the advantages and possibilities of elec-

tric transmission of power that there has been a strong tendency to exaggerate and to allow the spirit of prophecy to override conservative judgment. For instance, while it is theoretically possible to run the factories of Chicago by power transmitted from Niagara Falls, and while it is possible that a small plant of this kind may be installed at the World's Columbian Exposition as an illustration of what can be accomplished, still in the present state of the art such an enterprise would not be commercially feasible, nor is it likely, with all the improvements that will be made for many years to come, that the power of Niagara will be felt beyond a radius of a hundred miles. It is not intended to imply that this distance is necessarily the limit of successful and profitable transmission of



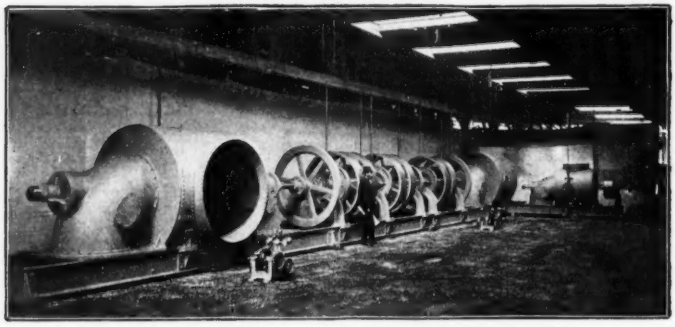
VICTOR TURBINES ON HORIZONTAL SHAFTS.

[For driving six dynamos direct from water-wheel shafts. Each turbine is independent and drives three dynamos, either one of which can be cut at will.]

power by electricity. It is quite possible that in the near future plants may be in commercial operation over even greater distances, but they will be in localities where fuel is sufficiently expensive to make the saving pay interest on the large investment required.

The question is frequently asked, "How far can water-power be successfully and profitably transmitted by electricity?" The answer depends upon many conditions. In one situation it might not pay to transmit power a mile, while in another it might be transmitted fifty miles and pay large dividends on the investment. The principal conditions affecting this question are the cost of water-power, cost of fuel where power is to be used, amount of

power required and number of hours used per day, and lastly the voltage or electrical "pressure" that can be employed satisfactorily. When it was discovered that the dynamo, which generates an electric current when its armature is revolved by some extraneous power, becomes a motor and will do work when a current is sent through it from another dynamo, and that this action can take place regardless of the distance between the two machines, the feasibility of transmitting power by electricity was at once recognized. In the enthusiasm over this discovery and its possible effects there has been quite a general tendency to overlook the important question of dollars and cents, which is the criterion by which the fate of every purely engineering or business enterprise must be determined. The manner in which the financial aspect of



PLANT OF THE OLYMPIA LIGHT AND POWER COMPANY.

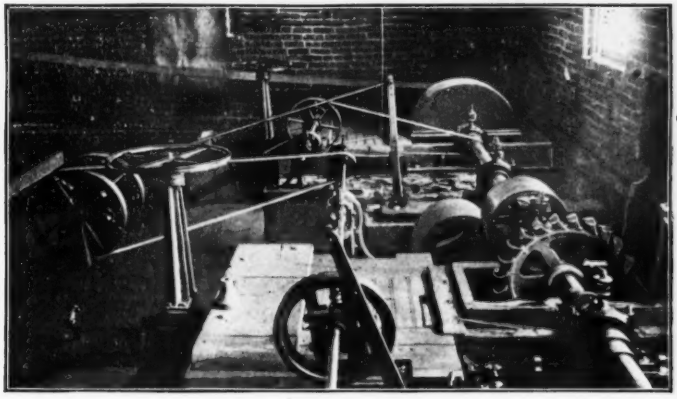
[Two pairs of 25-inch, and one single 17½-inch, Victor Turbines on horizontal shafts, used under 24-feet head.]

the question is affected by distance, voltage, and the other conditions named can be more clearly shown by a brief examination of some of the principles governing electric transmission of power.

The total efficiency of an electric-transmission plant (ratio of power delivered on motor pulley to power required to run dynamo) is usually between 60 and 70 per cent., there being a loss of 10 or 12 per cent. in converting mechanical into electrical energy in the dynamo, a similar loss in reconverting electrical into mechanical energy in the motor, and a loss in the line depending on the relation between the size of wire and the current transmitted. This line-loss (due, not to leakage, which is insignificant in a properly-insulated line, but to the waste of energy in overcoming the resistance of the conductor) may be made as

small as desired, no matter how great the distance, by using sufficiently large wire, but this involves additional expense, and it is evident that for each case a point will be reached where farther increase in size of wire would be inadvisable, as the interest on additional cost of copper would exceed the value of the power saved. In most cases the best loss in line, all things considered, will be between 10 and 20 per cent., which, with the losses in dynamo and motor, will give a total efficiency of 60 to 70 per cent.

The energy lost in line is dissipated in the form of heat, and the amount of energy so dissipated is equal to the square of the current multiplied by the resistance of the wire, this law being expressed by the equation $H=C^2 R$, in which H represents energy



ROARING FORK ELECTRIC COMPANY'S PLANT.

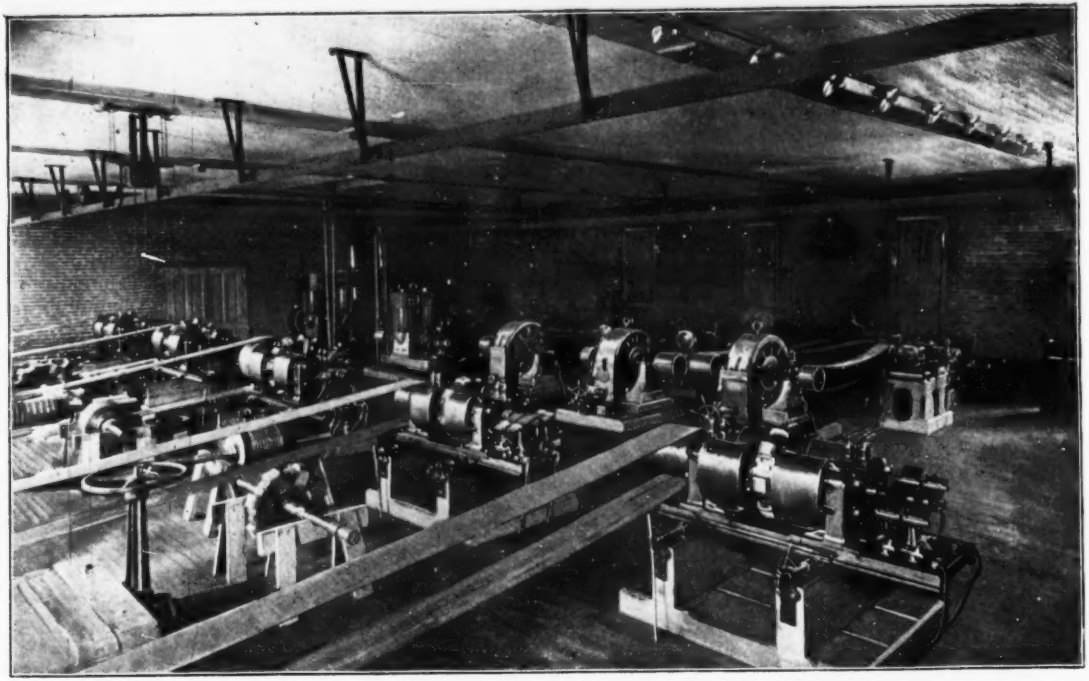
[Corner of power-house, showing Pelton water-wheel with cover removed, and Doolittle governor.]

converted into heat (measured in watts), C represents current (in ampères), and R resistance of wire (in ohms). As the resistance of a wire varies directly as its length and inversely as its cross-section, this resistance (and consequently the line-loss) will increase with the distance, unless the cross-section of wire is increased as rapidly as its length, which means that the weight of wire will increase as the square of the distance, and that its cost will soon become prohibitory. To keep the weight of wire constant as distance increases, the area of cross-section must be correspondingly decreased, which will make the resistance increase as the square of the distance. To keep the line-loss constant, the equation shows that

C^2 must be correspondingly decreased, which requires it to vary inversely as the square of the distance or C to vary inversely as the distance. How can this be done and still transmit the same amount of power? The answer to this question is suggested by the formula for the energy of an electric current, W (energy) = C E, E representing electro-motive force, commonly called voltage or "pressure," measured in volts. This equation shows that the same energy may be transmitted by a small current, provided the "pressure" is correspondingly increased (an analogy to water-power), and from what precedes it is evident that, if the electro-motive force increases in the same ratio as the distance, a given amount of energy can be transmitted with the same loss and the same total weight of wire, regardless of the distance.

This apparent avenue of escape from the difficulties of long-distance transmission is again blocked by the objectionable features of the high-voltage or "high-tension" current, chief among which is the difficulty of manufacturing dynamos and motors which will be proof against the almost uncontrollable desire of such current to puncture insulating materials, produce "short-circuits," "grounds," and "burn-outs," and make uncalled-for pyrotechnic displays around the commutator.

A partial solution of this difficulty is expected from the "three-phase" system recently experimented upon in Germany, where power was successfully transmitted from Lauffen to Frankfort, a distance of 108 miles. In this system the dynamo generates an alternating "three-phase" current of large "quantity" and low "pressure" or voltage, which is converted by a transformer into a current of small quantity and enormously high voltage (20,000 to 30,000 volts if necessary), that can be transmitted over a comparatively small wire and reconverted at the other end into a low-voltage current which operates the motors. The advantage of very high voltage in transmission is secured while avoiding its disadvantages in dynamos and motors. While the Lauffen-Frankfort installation was a scientific experiment rather than a commercial enterprise, still the results obtained are regarded as very encouraging, and the development of this method is expected to exert a powerful and beneficial influence on long-distance transmission. It must not be forgotten, however, that the transformers at both ends of the line add materially to the cost of the plant, and that the pole line and labor for such a distance, regardless of size of wire, become a serious item of expense, and that consequently



ROARING FORK ELECTRIC COMPANY'S PLANT, ASPEN, COLORADO.

electric transmission to very long distances must still be limited to cases where fuel is comparatively expensive and the saving is sufficient to pay interest on the required investment.

The foregoing discussion shows how the distance to which power can be transmitted profitably is affected by the question of voltage. The other conditions mentioned as affecting this problem require no detailed discussion, as it is evident that the saving effected by water-power over steam will be greater when water-power is cheap, fuel dear, and the work continuous, than when reverse conditions exist, and that the greater this saving the greater will be the justifiable investment in electric plant and the distance to which power can be profitably transmitted.

Equations and curves have been deduced showing in a general and approximate manner the cost and operating expenses of electric-transmission plants and the limits within which they will be profitable (pay 20 per cent. on investment) under various conditions. A few examples may be of interest here. If coal costs $4 per ton and power is used ten hours per day, 200 horse-power can be electrically transmitted four or five miles at 1000 volts E. M. F. and pay 20 per cent. per annum on the investment. If used steadily twenty-four hours per day, it can be transmitted eleven or twelve miles under the same conditions. If 2000 volts can be conveniently used, these distances will be nearly doubled; in fact, the limiting distance will increase almost in proportion to the voltage employed. Looking at the question from another standpoint, it may be shown that if coal costs $6 per ton at a mill where 100 horse-power is used twenty-four hours per day, and water-power can be developed at moderate cost at a distance of five miles from the mill, and there is no objection to using an E. M. F. of 2000 volts, the saving effected by using electric power will pay 50 to 60 per cent. per annum on the cost of the plant. If, however, this mill is in a locality where slack coal can be obtained for $1 per ton, and power is used only ten hours per day, it would not pay to install an electric plant if water-power could be had within a quarter of a mile, as the saving would not pay interest on cost of water-power, dynamo, and motor, without any line whatever. Examples might be multiplied indefinitely, but the instances mentioned are sufficient to show how impossible it is to give a general answer to the question: "How far can power be profitably transmitted by electricity?" and how necessary it is to carefully weigh all existing conditions. The cases cited show, however,

that, whatever may be the limiting distance to which power may eventually be transmitted profitably by electricity, there is at present a wide field for enterprises of this kind, presenting an attractive investment for capital, and nowhere are the advantages of electric power more striking than in the mining districts.

Aspen, Colorado, is entitled to the name of the pioneer camp for electric-mining machinery. The first electric hoist was installed there in 1888 and consisted of one of the earliest types of Sprague street-car motor geared to a flat friction hoist. It has been

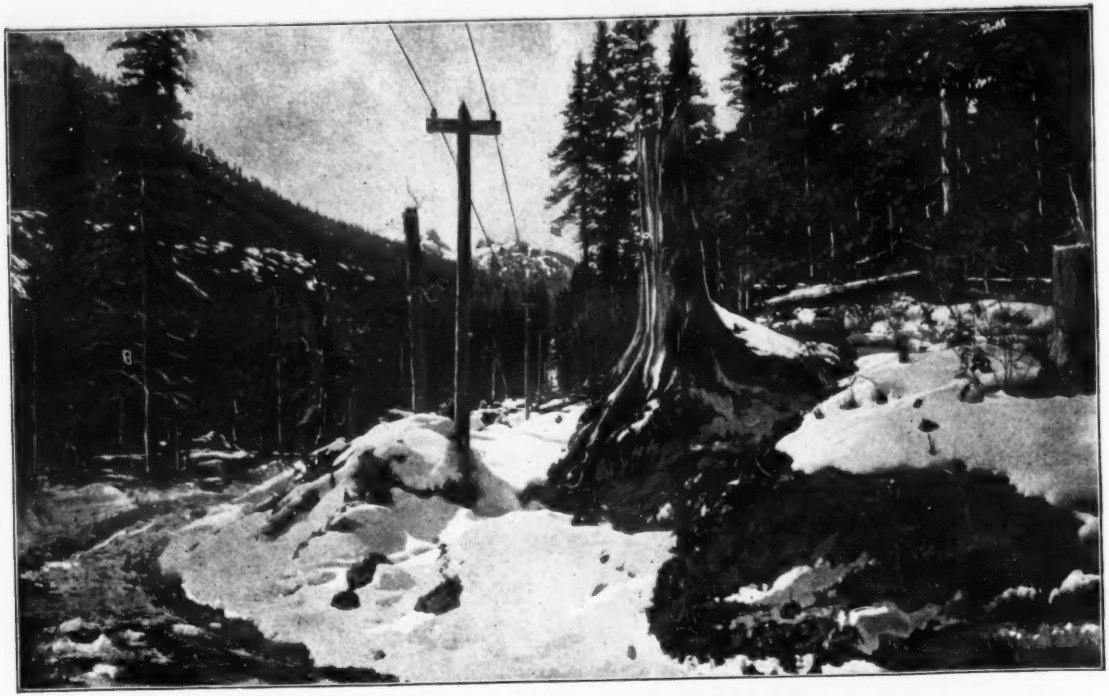
GENERATING STATION FOR ELECTRIC POWER PLANT, VIRGINIUS MINE.

in use ever since and is still giving satisfactory service. There are now at Aspen five electric hoists, three electric-diamond drills, three electrically-driven blowers for ventilating, a 20-horse-power motor running the sampling works, and several smaller motors used for various purposes, while many of the mines are lighted by incandescent lamps. The Aspen Mining and Smelting Company operates its own plant, consisting of two 50-horse power dynamos supplying current for three hoists, one diamond drill, one motor driving a blower, and another running a machine-shop, as well as

lights for the tunnels and workings. The other electric machinery, together with more than a hundred arc-lights and nearly 3000 incandescents for town and mines, are supplied from the plant of the Roaring Fork Electric Light and Power Company, which is one of the most interesting on the continent and is a good example of the mountain style of water-power and electric plant.

The mining town of Aspen is situated on Roaring Fork at its junction with Hunter creek, a small stream that tumbles down the ravine on the northwest side of Smuggler Mountain, on which are situated such famous mines as the Smuggler, Johnston, Della S., and the fabulously rich Mollie Gibson. On Hunter creek, about two-and-a-half miles from its mouth, a small dam is built, the principal objects of which are to give a sufficient body of water to avoid stoppage by surface and anchor ice and rubbish, and to provide a small reserve of water to tide over the early morning hours, when mountain streams fed from the melting snows are lowest. From this dam extends a flume twenty-four by eighteen inches, a distance of 9000 feet to a point on Smuggler Mountain, 876 feet above the power-house, which is located near the bank of Roaring Fork a little above the mouth of Hunter creek. From the end of the flume a wrought-iron pipe 4500 feet long extends straight down the mountain and across the gentle slope at its foot to the power-house, where it supplies water through nozzles to eight two-foot Pelton wheels, rated under this head of 876 feet at 175 horse-power each, which run the dynamos for supplying light and power. In the small view of the power-house is also shown the water-wheel governor, designed by Mr. Doolittle, manager of the company, which, by means of differential gearing, utilizes the difference in speed between a wheel with steady load and the wheel to be governed to move the nozzle of the latter wheel and vary the amount of water delivered against the buckets.

The quiet little stream flowing from the power-house gives no indication of the vast power that it has just been the means of generating, but this power can be appreciated by raising the covers from the wheels and looking at the water as it is hurled from the nozzles against the buckets, and if any further evidence of its terrific force be required, it can be obtained by attempting to pinch one of these little jets between the thumb and forefinger. The spray on its surface presents a velvety feeling to the touch, but when the fingers have sunk into the jet a sixteenth of an inch, it is as hard and impenetrable as if it were frozen, and it is said to be impossible to cut it with an axe.

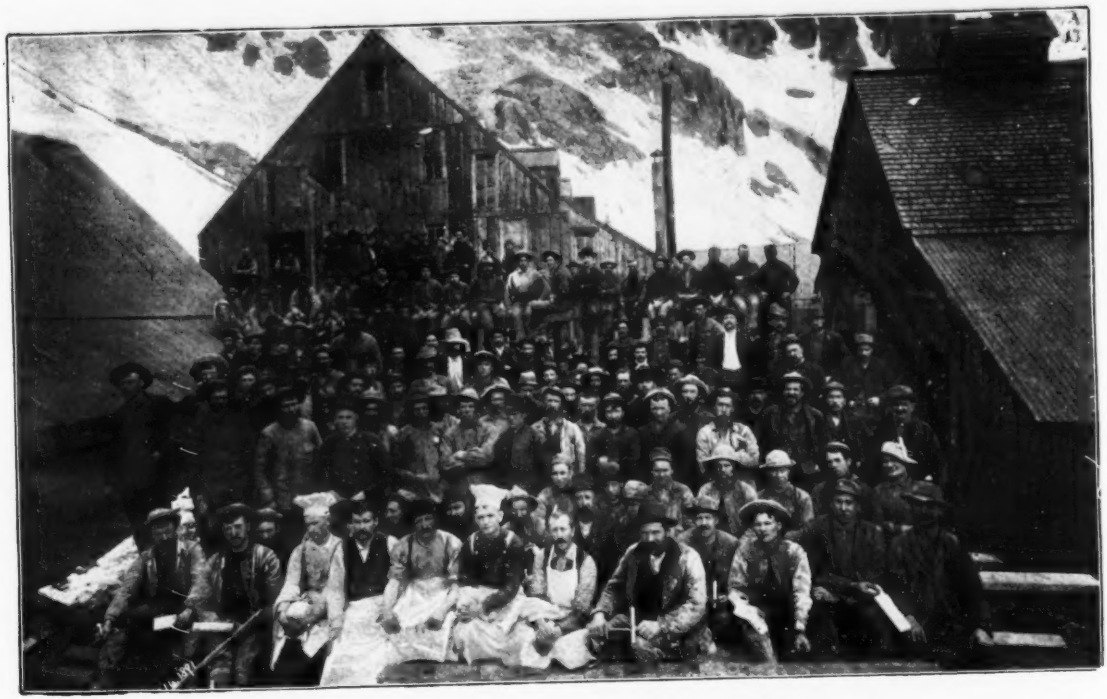


ELECTRIC POWER PLANT OF VIRGINIUS MINE, NEAR OURAY, COLORADO.

[View from generating station, looking westward along line.]

Probably the most remarkable electric plant in the country, all things considered, is the one at the Virginius mine, near Ouray, Colorado. The water-power is located on Red Cañon creek nearly four miles from the mine, which is near the top of Mt. Sneffles, far above timber-line in the region of perpetual snow, and at an altitude of 12,700 feet above the sea. The idea of transmitting this water-power to the mine by means of electricity, at a time when such an undertaking was regarded as a somewhat doubtful experiment, was very forcibly suggested by the fact that coal had to be packed to the mine on burros and cost delivered about $20 per ton, or $100 per day for the amount of power used at that time.

The power-plant is similar in its general features to the one at Aspen, just described. From the power-house the line extends for some distance up the cañon through dense timber, where the wires are subject to the danger of falling trees blown down by the terrific wind storms which prevail in that locality. Leaving the cañon, the wires are carried up a precipitous bluff, ornamented here and there with the carcasses of burros which have slipped or been crowded from the narrow trail known as "the zig-zag," effectually disproving the commonly-accepted theory that it is impossible to kill a burro. From timber-line, at the top of this bluff, the line is built across a rocky plateau, where the snow during the first winter covered the tops of some of the poles, which were at that time only twenty feet high, but which have since been replaced by longer ones. For the last half mile or so the poles are set along the base and on the sides of high cliffs, to avoid as far as possible the destructive snow-slide. The current is carried down the mine by the best waterproof cables, boxed for mutual protection of wires and men, the electric pressure (800 volts) being a little too strong to suit the taste of the average miner. The power (about 250 horse-power in all) is distributed among two pumps, one hoist, one blower, and two mills. It will be seen that this plant comprises nearly all kinds of machinery employed in mining operations, and encounters every difficulty to which electric plants are heir, including the worst enemy of electric machinery, lightning, in its most violent form. It is not surprising that troubles were experienced in the early operation of the plant, but the gratifying facts that these have been remedied and that the plant is running in a perfectly reliable and satisfactory manner are evidence that electricity in mining has come to stay.



BUILDINGS AND MINERS AT VIRGINIUS MINE—ALTITUDE 12,700 FEET.

It is a conservative statement that there are, in Colorado alone, hundreds of mines using steam-power produced by very expensive fuel that are sufficiently near to good water-power to be operated by electricity at a saving that would pay from 40 to 100 per cent. per annum on the investment, and it is not a wild prophecy to say that within the next three years scores of such plants, developing thousands of horse power, will be installed.

The effect of such enterprises will be powerful and widely felt. By decreasing the cost of mining and treating ores, mines which now pay will pay better, while many properties which, on account of low-grade ore or remoteness from railroads and fuel supply, cannot now be worked without a loss can be made by means of electric power to yield satisfactory profits. The effect will be to increase the metal output, give employment to more men, build up the mining towns, exert a beneficial reflex influence on the commercial cities, and in general benefit the entire mining districts.

Next to the silver question, the introduction of electric power is at present the most important factor affecting the development of the mining industry, and, unlike free coinage, electric power is not dependent on legislative action, but is entirely under the control of the mining men themselves.

SOCIALISM AND THE INDUSTRIAL CONQUEST.

By William Nelson Black.

M. PAUL DESCHANEL, the delegate sent by the French Chamber of Deputies to this country to study the condition of the American workmen, has made some flattering reflections on the spirit of individual initiative and independence which he found here. American workmen, he is reported to have said since his return to France, rather resent than court government interference with industrial affairs. It is to be feared either that the French labor plenipotentiary did not consider the condition of the American workmen who are said to work with their mouths, or that there is a spirit of abject dependence on government in Europe that is inconceivable to a man born and bred in the American Union. Surely he could not have met the chief of the Knights of Labor, the man who wants the Government to seize all the railways in the country. Neither could he have read the demands of those complex Grangers, workmen, capitalists, and political agitators who want Government to issue money and to open a universal pawnshop, with politicians in supreme authority to pass judgment upon the value of farm products offered as collateral security. Mr. Palmer had not then proclaimed State Socialism from the floor of the Senate as the remedy applicable to the Homestead troubles; nor had the loud-mouthed demand for compulsory arbitration gone up from an indiscriminate lot of workmen, politicians, and befuddled newspaper editors, who cannot see that State-enforced arbitration would only be another form of the ancient and hopeless effort to regulate wages by law.

But perhaps M. Deschanel was shrewd enough to distinguish the toilers of the tongue from the hand workmen ; and, not less for the honor of the country than for its continued growth, internal peace, and true greatness, it is to be hoped that he was an astute observer and truthful reporter.

But whatever the impression made on the French investigator, it is unquestionably true that a marked change has taken place in the United States during the last three decades, even though it cannot be truthfully said that the spirit of individual initiative is

becoming less manifest. Before the war men rarely used the word government, and, according to the recollections of the writer, it was still more rarely spelled with a capital letter. By common consent the word was tabooed in favor of certain less offensive terms, such as Congress or the Legislatures, and it was commonly boasted that a man could travel all over the Union and never see any sign that a government existed. The word occurs but once in the original Constitution of the United States, and in that instance only in relations that make it seem more like a reminder of some latent property than the distinctive designation of an entity. But with the outbreak of the civil war there came a change. The word Government, dressed in the full canonicals of the German Kaiser or Russian Czar, was marshaled to the front and placed at the head of the political vocabulary.

Various causes have combined since the close of the war to keep the word habited in its new uniform. First came the period of reconstruction, when Congress thought it necessary to secure the fruits of victory by holding the defeated but hardly conquered section in liens stronger than the constitution had prepared. Few will probably be found now in any party who will not admit that the attempt was demoralizing, and that it served to make what was only meant for an expedient seem like the assumption of new constitutional powers. The great body of our people, even among those born and bred in the country, have an instinctive rather than a logical sense of constitutional principles, and they are easily misled when leaders go astray.

Then again, we derived from the war a banking system, which is no better than the banks themselves could maintain by coöperative combination. It is in fact not nearly so good; for a tacit coöperative system has been partially developed by recent panics, and it has proved to be the happiest idea in banking ever suggested. The use of clearing-house certificates, if made a properly regulated feature of banking operations, could protect the public better than bond deposits for security of circulation, or political bank examiners; and very little careful examination of the subject is necessary to see that this must, in some form, become the practicable substitute for our present national banking system when the national debt has been paid. But the national banks are better than the old wildcat banks formerly maintained, and this has reconciled the people to government intrusion in finance,—an intrusion that could hardly fail of letting loose a cloud of uncon-

stitutional vagaries, culminating finally in the sub-treasury scheme of the Farmers' Alliance.

Nor was the civil war the only event that caused the people of this country to write government with a capital letter. Other wars have had their influence. Strangely enough, the very events that caused the French people to recover their heads caused an incalculable number of men in this country to lose their heads. After the battle of Sedan the American press became substantially daft in its admiration for Bismarck. The reactionary German feudalist and imperialist became the representative great man of the period, and no terms of laudation could be too fulsome for his merits. No matter how detestable the measure when tested by the American constitution, if it was only approved by Bismarck it must be entitled to consideration. Did he need the railways as a means for increasing the revenues demanded in the support of his colossal army and to facilitate mobilization? Why, then, the idea of government railways must be an admirable conception, and all governments might do worse than to get hold of the railways, those powerful conservators of independence when held by the people. Did he need the telegraph for corresponding reasons, supplemented by the additional reason that the telegraph could be made a more prompt political engine for the confusion of all enemies than even the railways? Then a government telegraph must be the correct thing. Outside of France the populace everywhere became intoxicated with the German doctor's strong constitutional stimulant, and the personal ideals of all other countries began to shine with only a flickering light in the blaze of the new meteor. Even America, nursed in the tradition of the men who fought all the way from Lexington to Yorktown, often barefoot and coatless, against everything that Bismarck has been understood to represent, could not altogether resist the fumes of the intoxicant.

Finally, there is a third reason for the change, and it is a curious reason. The men who suffer most from excessive government are the men who have least money. Money can always buy exemptions and privileges; and there is no place where it can be used more effectively than among those who have exemptions and privileges to sell. The men who must be marshaled in the front rank in the battles of strong government, and who must bear its chief burdens in either peace or war, are the men who have no means of buying a substitute or shifting their load. Notwithstanding these well-known facts, however,—facts as well known in the United States as

elsewhere,—we have an incalculable number of idiots who are willing to assume that government stands ready to ally itself with the poor against the rich if it only receives the encouragement. Hence such literary effusions as "Progress and Poverty" and "Looking Backward,"—books written by men so ignorant of rudimentary political history that they do not know when they are advocating a restoration of conditions always inherent and constituent among savages, and that all civilization is the fruit of a prolonged and painful effort at escape to higher ground.

Nevertheless it is impossible to ignore the fact that State Socialism, so called, has made some impression in the United States, and that it is accomplishing something in strengthening the hand of the political official and enlarging his opportunities. Unquestionably it is an ally of imperialism, and an ally upon which even imperialism looks with such contempt that it will consent to follow its precepts only to the limits that will best enable it to maintain its alliance with the rich. But it is an ally that makes the beneficiaries of strong government, and all men who draw the chief part of their subsistence from political fountains, seem ungrateful to the last degree when they fail of recognizing their obligations.

But it will hardly be necessary to pursue this line of discussion further. The American people have been actively at work during the last fifty years and more in providing the conditions which must soon make the professional ruler unnecessary. They have been intently engaged in perfecting the system and works of incorporation; and the fruits of their labor are seen in the construction of more miles of steam railway than all the rest of the world contains, in the stringing of telegraph lines enough to make communication all over the three million square miles of the American Union next to instantaneous, in thousands of miles of electric railways, in hundreds of thousands of telephones, in millions of electric lights, in the upturning of illimitable stores of coal, iron, lead, gold, and silver, and in a general industrial development unparalleled in the history of the world. They are still most intently engaged at this work; and to ask them to waste time in a study of the fossils of rudimentary society, or of conditions once institutional in the now defunct Roman Empire, might be to make trial of their patience.

Yet, how very few men seem to comprehend their environment and the tendencies of the times. Read the public press throughout the American Union,—the country above all others the most industrially active and least enchained to its political superstitions,—and

see how large is the space given to political discussion and news, or to the outgivings of princes and politicians abroad and of politicians at home. Then observe further how small the space left, after the scandals have received their due measure of consideration, for the treatment of those matters upon which the real greatness of the country depends.

We often hear it said that the better class of citizens in this country will no longer pay attention to public duties, and that, as a consequence, political management is continually falling into fewer and more corrupt hands. The saying would be true were public duties and political duties synonymous forms of expression. But as a matter of fact it is not in the least true. The better class of citizens are intensely absorbed in their public duties. The railway president or superintendent goes each morning to the offices of the company for the purpose of directing the transfer, at perilous rates of speed, of the thousands of passengers who are forced to trust themselves to his safe conduct over ways that may have been impaired by frost or flood. Is there a man in the Senate Chamber at Washington whose public responsibility is as great? The very locomotive engineer who drives the fast express is a much more important public functionary than any department clerk in the national capital; and the civil engineer who is planning a railway bridge or superintending its construction could hardly be excused if he thought his duty to the public could be best discharged by laying aside his work to attend a ward primary. The day has come when the very head of a large factory has more important public duties to perform than the head of a municipal department. The head of the factory could not well be spared were the factory to disappear with its representative; but we would all be better off were not only the head of the municipal department but the department itself displaced.

These are the facts in American life, and they are the facts with which we have to reckon. Men of the highest qualifications are retiring from political management because they find its operations futile. They are tired of laws conceived only for purposes of political chicane, and designed rather to interfere with personal liberty and to obstruct than to confer benefits. Men are quite right in assuming that the better citizens are becoming more and more neglectful of their so-called political duties. But they are mistaken as to the cause. They attribute it to absorption in personal and selfish objects, when, as a matter of fact, it is due to the

promptings of a higher instinct. None are so sympathetic and broad as the better citizens, many of whom almost forget the date of even a general election, and would forget to register were it not for the frantic promptings in the editorial pages of the daily press.

The question recurs here if we can ever look for an amendment in this particular. Evidently not; for the causes that have produced this indifference are still at work, and the more farsighted men, instead of amending their habits, will be more likely to inquire if any amendment along political lines is desirable. The trend is still upward. If the men of best qualifications have no longer a wish to attend to political affairs, it is because political affairs are no longer thought worthy of attention; and the road which the best men are following is the road that all men will follow when they have had time to get the direction. It ought not to take many more political processions through the streets of our great cities to convince gray-haired old men of the better-citizen kind that they are playing in a very childish game, altogether unworthy of their ripe and venerable aspect.

But is there not danger, while the political superstition still holds the masses of men, in permitting this continual descent into official corruption? Well, yes, there may be some danger. There may be danger that the pockets of the public will be yet more deeply explored, and that a still larger proportion of their contents may be abstracted. But the loss may not be altogether without compensation. If it be true that the best way to secure the repeal of a bad law is to enforce it, it should be equally true that the best way to overturn an undeveloped and objectionable system will be to let it betray its worst features.

It has been asserted that Herbert Spencer is sufficiently pessimistic to think that State Socialism will be tried, and that it will only be broken down by the intolerable tyranny that it will entail. He probably thinks that, after men have been driven to their daily task by the lash of the political overseer,—an event certain to follow on a system of enforced and despotic industrial organization,—they will be ready to revolt. But if Mr. Spencer sees the future so gloomily, it is probably because he looks at it through the atmosphere of Europe. Europe, however, will reach the future through the universal republic; and it is a far cry from the republic to State Socialism.

The dream of the State Socialist is simply impossible of realization. His system could not be inaugurated until government

had seized and confiscated, or destroyed, all the property in being, and that attempt would lead to civil war. The attempt to obtain the property by purchase would only lead to the aggrandizement of both capitalist and politician. Is this not easily comprehensible? Then observe the process. The wealth of the United States, all in the hands of individuals, is now about $60,000,000,000. Then to get this property into the hands of the Government by purchase would demand the issue of $60,000,000,000 six per cent. Government bonds; and the men who received these bonds would not only still go on speculating, but they would forever own the country. The one thing and the only one thing that Henry George seemed to see clearly when writing his "Progress and Poverty" was the need for the confiscation of all land values, if he expected to see the fruition of his plans. Attempted confiscation and civil war must be the first step towards State Socialism; and the end of the struggle would not be State Socialism after all: it would be either a complete overthrow of political organization, and the final establishment of the voluntary economic system, or it would be what the man on horseback generally prefers,—imperialism. It seems hardly likely, therefore, that a man so thorough, comprehensive, and far-sighted as Herbert Spencer can really believe in anything like impending State Socialism. What we see that looks like a trend in the direction of this chimera is simply the fruit of an alliance between the politician and the crank for the promotion of public plunder.

And what interest, it may be asked, have the readers of THE ENGINEERING MAGAZINE for a political article of this character? It is a pity, in this age of enlightenment, that such a question should even suggest itself. The readers of the technical and industrial press are the men of all others who are most vitally concerned in such subjects. They are the men who plan and who do the world's real work,—who build our railroads, create our cities, harness the subtle powers of nature to our service, pay our bills, and lead the very fore-front of progressive civilization. Upon every hand they find their work hedged about and obstructed by mercenary politicians armed with legislative enactments, and not a day passes but they are presented with new schemes of political and governmental encroachment in fields that are essentially industrial. The very atmosphere is burdened with talk of government railroads, government telegraph, municipal waterworks, municipal gas-works, municipal electric-light stations; with river and harbor im-

provement which yields only "worthless government engineering"; with geological surveys at public expense and without purpose or use; and so on, clear up to the absurdities of rank State Socialism, politely termed Nationalism hereabouts. Now, it is of the first importance that our practical men-of-affairs should see not only that such political interference retards industrial development, but that it endangers personal liberty and free government. Every such interference adds to the tyranny of the statute-book and strengthens the hand of the political mercenary. Every such governmental encroachment should be confronted by the enlightened expert opinion of our practical men, and, wherever possible, active personal opposition should be offered. As the editor of *The Engineering and Mining Journal* has recently said, in stoutly opposing a governmental appropriation for timber tests: "Such work as this does not properly constitute a function of a republican government; and these should be limited as closely as possible to doing that which the citizens are unable to do for themselves. . . . The very foundation of free republican government is in the self-reliance of the citizen, and the looking to the Government to do what the citizen can do for himself is destructive of that foundation. . . . It is no argument to say that a thing is right or should be advocated because the majority wants it. It is the duty of the press to stand firm to right principles even when in the minority. . . . Nearly every custom which has grown to be recognized as an abuse of the functions of government had its origin in some plausible scheme to benefit the citizen. It is when government is entering upon a policy that has no logical stopping point short of pure socialism that the warning voice should be raised. It is easier to guide the formation of correct principles than to eradicate erroneous convictions."

EFFECTS OF FLOODS IN WESTERN RIVERS.

By Charles B. Going, Ph. B.

FROM time immemorial rivers have been, both in fact and in figure, among the most important of terrestrial phenomena. One of the earliest topographical descriptions given us is of the river dividing into four heads, the first whereof encompasses the land of Havilah and the second surrounds the land of Cush; and almost the latest mystery of geography concerned the source of the Nile. Religion and poetry, history and romance, wealth of metaphor and wealth of dollars cluster about the streams of the world. In their motion, their changefulness, their responsiveness to moods of nature, they seem almost living and organic amid the inorganic creation. The inundations of the Nile stand as a type of beneficence, opposed to malignity typified in the "swellings of Jordan." The name of the Amazon, the Rhine, or the Ganges calls to mind a conception of character and influence more real, perhaps, than that of many an historical personage.

But our practical century, bringing triumphantly to solution, one after another, the mysteries of the ages, has not withheld its analytical research in this sphere. Scarcely over one hundred years ago Frisi seriously discussed the theory that rivers were fed at their sources by direct supply from the distant sea. To-day the signal service, consulting topographical maps and daily reports of rainfall, is issuing accurate bulletins long in advance of the stage of water to be expected at given stations on our erratic western streams.

To one familiar with the constancy of the Delaware or the Hudson, which yield only to the semi-diurnal swinging of the tide, any disquisition upon the changeability of rivers seemeth as the words of an unknown tongue. Even in the smaller eastern streams generations of boys have resorted to the same "swimming-holes," and dived with undisturbed confidence, year after year, from the same rock into the same deep water. But their western cousins may find a ripple over the gravel this week in a spot where last week they could barely "fetch bottom"; and in the large rivers pilots often find the channel entirely changed between seasons, or indeed

may pole their boats down over the sand-bars, and on the return-trip make their way, with abundant water, through the corn-fields of an upper terrace.

It is in difference of topography and of soil that we find the causes of this wide unlikeness between eastern and western rivers. The seaward slope of the Alleghanies, like that of most great mountain chains, is short, steep, and in general covered by a comparatively thin soil. It extends to its resident population little inducement to agriculture and much to commerce. From these causes mainly there result, first, the confining of the rivers to straight, direct channels, determined by and unchangeably shaped within the folds of the rocky strata; and second, the preservation of large tracts of wooded and undrained swamp lands, which act as storage reservoirs for the temporary retention of excessive rainfall and the gradual distribution thereof to the streams. Hardly do these pass beyond the reach of such influences to the plain before they meet the great equalizing ebb and flow of the tide; and while ice-gorges or spring freshets may swell, and severe droughts diminish, the upper reaches, or a strong wind at the spring-tides cause an unusual level below, yet the main characteristics of our eastern rivers are stability of volume and constancy of form.

The western declivity of the mountains, however, presents far different features. It stretches out in a long, gradual slope to the great interior basin, which has for surface the semi-solidified strata laid down in late geologic seas, and still more largely the deep deposit of loose glacial drift, or of alluvium brought down by the rivers of earlier ages. This sedimentary character of the soil is a guarantee of richness in agricultural possibilities, and its great depth insures lasting fertility. Here lies the great producing section of our country. And as enhanced value of land necessarily follows clearing, each owner seeks by all means to secure the use of every foot within his boundaries. The axe and the ditching plow are never idle; every year finds additional tens of thousands of acres cleared and drained; and fresh miles of ditches and of tiling hurry faster into the streams the rain of each succeeding storm.

But one result can follow this condition, and that of course is the continual fluctuation of the rivers within wide limits, immediately corresponding to the variations of rainfall. When all water except such as the soil can actually absorb is rushed into the stream within a few hours of the time of its fall, it is manifest,

not only that no stability of volume is in any way possible, but also that herein, more than in any other one cause, must lie the explanation of the yearly increasing danger of and damage from floods. When in addition we consider the soft and yielding nature of the bed and banks, formed entirely in loose sands and gravels or washing clays, and devoid for the most part of any fixed rocky barriers, it is not surprising that currents of such changeful force and volume should produce cutting and erosion, changing from time to time in location, and varied in amount.

And yet this wash does not proceed in any haphazard manner, but in accordance with certain simple principles, of which the most important may be briefly stated. First, the continual effort of a stream is to arrive at a constant and uniform slope of surface, as nearly as may be. Second, to quote the words of Captain Leach, "no matter with what velocity the river is flowing and no matter what amount of sediment it may be carrying, if the velocity be decreased, some of the sediment will be deposited,"—a proposition of which the converse is also true, though with limitation. Third, there is always a tendency to cut into the concave bank of a curve, and build up the salient point opposite. And fourth, whenever the current impinges obliquely upon a bank, it will be reflected upon the other bank, so that the formation of a curve in either direction will naturally be followed by the appearance of a corresponding curve in the opposite direction, a little further down stream.

In their action the principles are really grouped in pairs, the first two affecting chiefly the depth and the last two the direction and contour of the river. Under the influence of the former, there is constant removal of material from the bed by the swift waters at the head of a cascade, and deposition in the eddy at the foot; until, through the combined effect of lowering above and raising below, the erstwhile cascade becomes a rapid, and finally, through continual lengthening of its horizontal dimension in proportion to the vertical, disappears nearly or wholly in the general surface slope of the stream. From the increase of carrying power with acceleration of speed arise the scourings during freshets of large channels in softer portions of the bed, and the carrying of deep water with the sweep of the current to the outside of every curve. To the other phase of the other principle (the laying-down by the water of part of its load whenever its velocity is retarded) is due the partial filling-up of those flood-scoured portions of the channel when, the water having fallen, a diminished stream finds them

slack-water pools, through the center of which only a constant current is maintained, while dropping of sediment goes on continually in the quiet waters on the margin and toward the bottom. The last-named cause leads also to the formation of sand-bars behind any obstruction which makes a "lee," sheltered from the full force of the current; and this whether the barrier be solid, as for instance an island, or merely the cross current of some eddy or tributary.

Indeed, the building up of the convex bank of a curve, spoken of under the third heading, is really but a phase of the varying capacity for transporting silt. The current entering a bend from the upper tangent continually works against the outer bank, leaving still water or an up-stream eddy on the other shore; and into these quiet reaches are carried and dropped, not only sediment brought from the upper river, but also the materials washed from the concave bank by the ever encroaching waters.

But by far the greatest change in the appearance of rivers is occasioned by the last group of processes. The tendency to enlarge curves is due of course merely to mechanical action of the current upon the yielding bank materials, and is carried on only upon the outer side, against which the rush of the water comes. To this is due the feature, universally to be noticed, of a precipitous descent into the stream on the outer bank of every bend; for the continuous undermining of the shore leads to repeated land-slips, and the resulting slope is left as steep as the "angle of repose" for the material will permit. The opposite bank, continually filled in by quiet water deposits, follows outward in a parallel curve, and this process continues until one of two conditions results. The stream may become so elongated by the increased range of its meanderings that the same total amount of fall distributed through so many more miles will no longer produce sufficient current to wash away the bank, when of course all further cutting will cease. Or—which more frequently happens—two alternate curves, continually approaching by their enlargement, may meet at their tangent points and establish a "cut-off," through which the water will rush with a velocity due to fall previously distributed throughout the long and now abandoned intervening bend. Such "cut-offs" are continually occurring, as the present and ancient courses of the Mississippi clearly witness; and as their completion would often replace from ten to twenty miles detour around the bend, by a direct channel of a mile or less through the neck, the artificial hastening of such work is likely to be urged by navigating interests.

It will be sufficient here to note one result of the opening of a cut-off. The concentration into the short new pass of many times the usual number of inches fall per mile found in the rest of the river would primarily result in the formation of a comparatively steep slope joining the more nearly horizontal upper and lower stretches. But the final outcome is a draining-off of the upper level by the rapid flow through the pass, and a banking up of the lower one from the same cause, until, under the law already laid down, a uniform slope of surface is attained. This involves of course the permanent raising of the river below the cut; a matter often of great menace and increased injury by flood to property bordering thereon.

Another result which might follow upon the establishment of a cut-off is a rearrangement of the curves of the river below, under the operation of the fourth principle above indicated. The action of the current is somewhat like that of a marble rolling down an inclined trough, and zigzagging from side to side as it bounces from one wall of the trough to the other in its descent. While guided by much less simple laws, and influenced by many external causes, the stream, when once its course has been deflected to either bank, is passed back and forth much as the marble; cutting into the bank at every point of impact, and eventually forming a curve at each such point.

Evidently the sweep of the current out of a new cut, in a new direction, may easily chance to impinge upon a portion of shore previously unaffected by it, and the inevitable result will be a curving in of the bank at that point. Swerving off from this again, the wash will come against a part of the opposite bank hitherto free from its action; and a similar readjustment may continue for considerable distance below. The evidence of such changes may be seen along many a western river. Old channels, long since dry, are still distinctly marked in banks and bed, and even preserve in many cases the marginal line of sycamores. Here and there a steep-walled cut gouged into the side of a hill, though now removed from the water's edge by the full width of some broad field, shows where the elbow of a bend was formerly situated; and in larger rivers the divergence between the occupied and abandoned channels may lead them twenty miles or more apart.

Not long since the Supreme Court was called upon to decide, as between Kentucky and Indiana, the State ownership of a tract of land transferred by a change of channel to the north side of the

Ohio river. It is interesting to note that the decision established as the proper boundary low water-mark on the northern side of the river (this being the usual limit of Kentucky jurisdiction), at the time the State line was originally fixed, and regardless of subsequent changes; and an excellent indication of the frequency of such changes is afforded by the wide interest felt in the ruling in this case, on account of its effect upon territory similarly transferred elsewhere.

In a smaller way the creeks of our central and western states are continually creating similar confusion in farm and homestead boundaries. They may without compunction devote their energies to transferring a man's best field to his trans-riparian neighbor, and only offset the unnecessary generosity by the entire impartiality with which they may, at any time, reverse the order of giving.

It is almost always the case that the valley of a stream flowing through drift deposits appears extraordinarily large in proportion to the volume of the watercourse occupying it, particularly when it is remembered that this valley is generally due wholly to the erosion accomplished by the stream itself. In some cases modern streams are occupying the beds scoured out by former mighty glaciers or glacial rivers; but very often the phenomenon is attributable solely to the constantly shifting course of the waters, working repeatedly from one side to the other of the gradually forming valley, and cutting it wider and deeper in their travels.

A very striking feature of alluvial streams is the identity of form and action in the smallest rivulets and the largest rivers. The difference is only in scale, and the cutting of banks, the shifting of channel, the influence of obstructions, and the formation of a delta may be studied even in the tiny pasture brook.

These are but a few hints at the problems which have occupied the life-thought of great engineers, with results as magnificent as have been reached in any field of science. It is true that correct diagnosis is not in itself cure, but it is the first and essential step toward it. The powers and agencies at work in a great river are gigantic, but, given a true and definite knowledge of their character and operation, we may reasonably hope for advance to the ability to control. Not by treatment of symptoms merely,—for so might be termed the dredging-out of a filling channel or the facing of a washing shore with timber, brush, or stone,—but by directing the river itself to works of improvement rather than deterioration, and causing it to effect removal where removal is desired, and to

deposit wherever it is requisite to protect or to fill in. And indeed much is already accomplished in that line. Capt. S. S. Leach says "a caving bank can be protected or a secondary channel closed with as much certainty as pertains to the building of a road or the digging of a canal": and Mr. C. Ellet, Jr., in his work on the Ohio and Mississippi rivers, goes far beyond this, setting forth a plan of surplus storage reservoirs by which, he insists, floods on the Ohio may be absolutely avoided and a practically constant stage maintained along the entire river throughout the year.

It is unfortunate that the really great achievements of engineering in this field have been prejudiced in the popular judgment by the imperfect control yet attained over the Mississippi. Every break and overflow, telegraphed and bulletined the country over, is seized upon by the interested and accepted by many of the disinterested as evidence of the "failure of the levee system"; and the quiet favorable testimony of a hundred miles of levees standing is lost in the clamor over a hundred yards that give way.

But a fair examination might show the failure to result, not from wrong principle, but from faulty execution. Much of the work has been done piecemeal, by a mingling of private, State, and national enterprise, sometimes with inadequate skill, often with insufficient funds. In many places the greatest and most unruly river of the Continent, at a flood stage, is asked to respect an embankment which would not ordinarily be trusted to retain the quiet waters of a canal. Not until the present work of improving and strengthening is completed can any fair test be reached, or the correctness of the principle involved, perhaps, find public demonstration.

In these days the accomplishment of any engineering feat whatever seems a question, not of possibility, but merely of a sufficient appropriation. Having given in this case two great known factors,—the source of the river's supply, and the laws of conduct of the waters in the channel,—it seems reasonable that the problem of their government should be solvable. Prejudice, interest, and ignorance may oppose the work in places; differences of opinion still exist on important points; there is unquestionably much yet to be known, both as to theory and its practical application; but in the main man evidences here as elsewhere his progress toward the fulfillment of the grand work given him "to replenish the earth and subdue it."

IS THE EAST A FIELD FOR ENTERPRISE?

By James G. Cannon.

IT has been said that the American citizen is "the embodiment of enterprise and pluck," and when we consider the wonderful growth and development of the Western world and reflect on what has been accomplished during the few years of our national existence we cannot but realize the truth of the prophetic utterance of Bishop Berkeley many years ago: "Westward the Star of Empire takes its way." The American citizen has also been called "a bundle of nerves," and surely it must be admitted that he is filled to overflowing with nerve force, and, like the thoroughbred racehorse, he runs until he drops.

Pluck, enterprise, and thrift are the elements that make up the American character, and it seems as if the early settlers of the West were imbued with that spirit of heroism which impels men to override all obstacles in the accomplishment of great results. We of the East cannot appreciate the fearless energy with which the frontiersmen of the West have followed the Star of Empire and opened up this great granary of the world, until we have the ocular proof which only a visit to the West can give. No one can go west of the Mississippi river without being impressed with the progressive energy of the people of that section of the country, and the sight of a thousand-acre corn-field and a herd of 100,000 cattle gives an idea of the wholesale way in which a Western farmer does business.

The West is far ahead of the East in the architectural beauty of its cities and all modern conveniences, such as electric- and cable-railways, electric lights, waterworks, sewerage systems, etc. The people have an air of alertness and a keenness of perception which is not always noticeable in some of our Eastern States, where habits are more methodical and where business is transacted in a more quiet way.

The citizen of the West is noted for his public spirit, especially in regard to the town or city in which he resides. He is willing to contribute money to almost any enterprise that will promote the welfare of his section of country; in fact, he takes an active interest in every-

thing pertaining to the advancement and growth of the city or town in which he makes his home. It is amusing to notice, on the other hand, the vigor with which he disparages the neighboring towns and how graphically he describes all the imperfections and disadvantages which they possess.

When the Eastern traveler visits the leading cities of the West, he observes that they are modern, with wide streets, imposing public buildings, and beautiful dwellings, their whole tone speaking of the latest achievements in arts and manufactures; as he looks upon his surroundings, a feeling of kinship is aroused within him, for he realizes that the East has provided, not only the necessary money, but also the people to till the soil, build the cities, and develop the varied industries of this vast domain.

In the course of a journey through the State of Texas some time ago, I noticed that many of my fellow-travelers were anxious to see certain court-houses and school buildings in the towns through which the railroad ran, and, as they were nearly all Eastern men, I was somewhat surprised that they should show such an active interest in the little towns of Texas. But I afterwards found that many of them held in their strong-boxes in New York bonds which were issued to erect these fine buildings; and there is hardly an investor who is not in some way interested in the great West or the South.

Just at present there seems to be a halt in all new enterprises, and, while there is a plethora of money, there appears to be also a hesitancy on the part of the investing public to put their money into new business schemes. Apparently two causes have led to this feeling; the first is want of confidence, and the second is the tampering with the circulating medium of this country.

Persons who have money to invest not only require the prompt payment of their interest, but they also demand satisfactory proof that the principal is safe. Frontier points have been overrun with new enterprises, and the people who have invested their money in them in many instances have received very large returns in the way of interest, and, with the growth of the country, the enactment of new laws, and the excellent handling of the properties, they have been able to make these investments very remunerative; or, in other words, they have "made the penalty fit the crime" of taking the risk of investing their money in a new country and receiving therefore a high rate of interest. This I would call the first epoch of Western investments. The men who made these investments

staked their all upon the growth of the country ; they went forward and developed its industries, and were the men who were entitled to receive the large profit which would accrue to them for such action.

The second epoch of Western investments began about six or seven years ago, when there were floated upon the Eastern market an enormous volume of Western securities, some of them meritorious, others with little to recommend them. These were eagerly snapped up by Eastern investors, many of whom had friends who had been fortunate in previous investments of this character, and they saw before them visions of increasing wealth.

In this last stage might be classed the great real estate "booms" of the Western cities and the "farm-mortgage boom,"— so-called ; and, in reverting to these two great factors, I do not speak disparagingly of either of these agencies, which have been so vividly presented to the investing public during the last few years. Any one who has visited the West where the great real-estate booms have been in progress cannot fail to see that, while these booms have left some of the cities and towns without a spark of life in them, they have been of great benefit to that section of the country, in that they have brought Eastern capital, which was in many instances invested in permanent improvements. The Western people, as a rule, claim that they are not the boomers, and that the money which was sent forward and the booming that was done came entirely from the East.

The farm-mortgage boom was a peculiar one, and its effects are now being felt more especially in the New England States, where farm mortgages were easily sold and where thousands of them were placed. While the boom in the West lasted, the interest was promptly paid, but many of these booms are now languishing, and it is doubtful whether they can be brought to life again.

This second epoch of Western investments affected a very much larger class of people in the East than the first ; and the result has been shown by a want of confidence in the Western securities and Western enterprises in general.

Many investors have been timid in putting their money into new business schemes on account of the tampering with the circulating medium of our country. The "silver craze," which has had possession of a large number of the American people for the last few years, but which now seems, happily, to be near its end, has done as much as anything else to make capital timid and pre-

vent its investment in new business schemes. It has made merchants conservative, bankers cautious, and lenders of money more careful than usual in regard to the investment of their principal.

In the nature of things the West, being the producer of silver, has quite naturally been the chief exponent of free coinage; but it now sees, as well as the East, that the free coinage of silver is not for the best good of this country, and especially so as it looks around in search of new capital to carry on its enterprises and finds that it is timid in coming forward. Even in Colorado, that great silver State, one can see dimly, while many of its citizens do not like to admit it, an entire change of heart on the silver question, and that they are not so rampant for "free silver" as formerly.

This agitation of the silver question has driven capital from investments, capitalists have deposited their principal in banks in the great cities, business has been retarded, and we are just now confronted with a plethora of money and with no disposition to invest. It is like holding one of the great arteries of your arm; the blood becomes congested above, and below the hand withers away. So it is with the circulating medium of a nation; attack it, and frighten investors, and it becomes congested in great centers and scarce where it is most needed.

If the silver agitation is done away with and the "Sherman Act" repealed, I predict a splendid future for new investments, and I believe we will then enter upon the third epoch—so to speak—of modern investments, which, like the others, will start from the East and work West. It will start if an honesty of purpose is manifested in new enterprises, that all interested may have good returns, instead of a few being enriched at the expense of the many.

The bold faith of the managers of new enterprises in the West has been wonderful,—they have staked their all in carrying them forward,—and the faith of the Eastern men in their Western brethren has been marvelous. Few of us realize upon what a great foundation of faith and trust in each other the business of this country is based.

We are about entering upon a new era of financial enterprise, and it would seem that the East would be the first to feel its effects. Inventors have crowded each other forward, and the West, with its quickness of perception, has taken advantage of these late inventions and advanced methods of transacting business; but the East will now benefit by the experience of the West. The re-

sults are already manifestly noticeable in our great railroad systems in the East. The managers are beginning to realize the benefits of straight tracks, cutting down of grades, direct communication between objective points, and the use of air-brakes of improved pattern ; and they are bestowing the greatest care upon the most minute details which the traffic demands,—all of which, to more or less extent, had been neglected at home.

There is a great field in the East for electric railways, which have developed so rapidly in the West. In the small towns in the Eastern States, the time will soon come when nearly all of them will be connected by electric railways ; and this will also give the towns electric lights, etc. Here is an employment for capital at home in the East which is certain, in time, to be very profitable. Take another field for enterprise which is not at all familiar to the Eastern man,—that of the manufacture of windmills. In the West there are thousands of them, doing the work which is being done in the East by manual labor. The time will come when the farmers of the East cannot do without them. Take the matter of water-supply for villages, sewerage systems, and many other undertakings of this nature, as well as the many industrial enterprises that are being put upon the market, all of which during the next decade will offer inducements at home to the investor in the East. There are many mines in the East which are now lost sight of and unknown on account of the great mines of the West, and which will pay when developed upon an economical scale, with improved machinery and new methods.

There will be cheaper money with which to carry on these enterprises, as it will not cost as much in the old-settled sections of our country to carry these things forward as in a new country. By cheaper money in this connection, I do not mean the cheap money of Europe, but I do mean that the high rates of early Western investments will not prevail. I believe, however, that capital in the United States will always afford a much better and safer return upon the money invested than in any other country in the world, and we will, during the next generation, afford the capitalist good use for his money at remunerative rates ; and when capital is employed it means employment to the working-man, and this means general prosperity to the whole country.

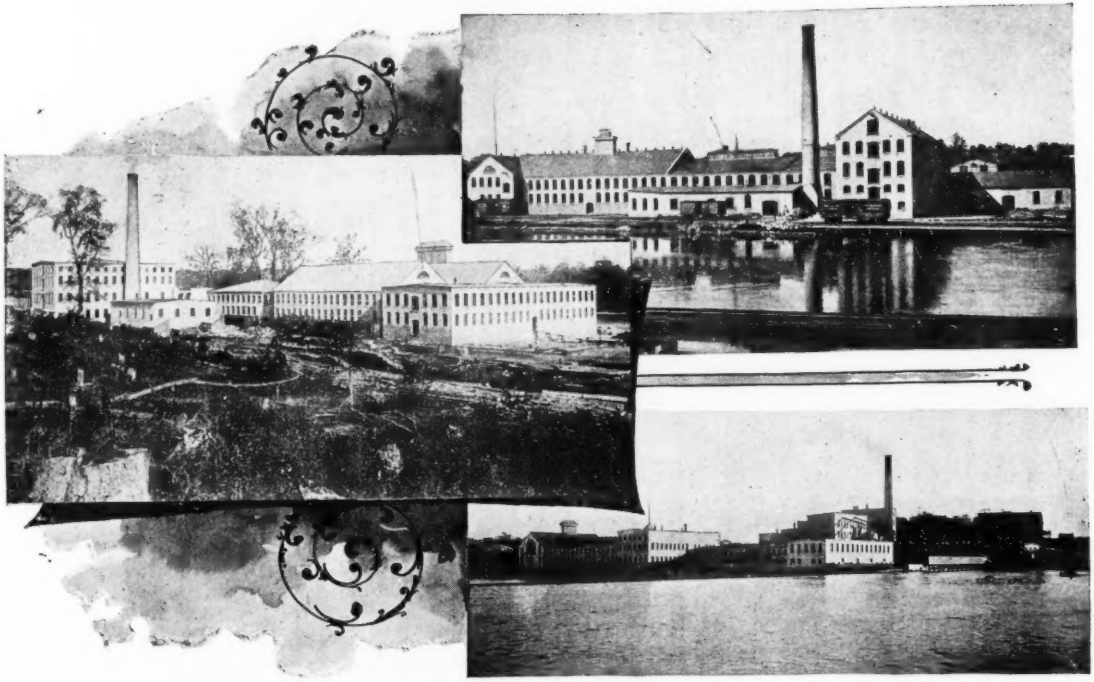
As we look in a mirror, with a strong light at our backs, the light is thrown from the mirror in our faces. So the strong reflection comes back from the West upon the East of its wonderful

enterprise and prosperity, and infuses into the East new ideas and opens fields for investment in the East which will gradually again reach the West, to its great advantage.

I have mentioned a few out of the many mechanical investments which will find their way into the markets of the East, and there are many more which might be mentioned. During the last five years there have been a large number of national banks started in the United States. This movement will probably continue, but there is a new field opening for investment in the Eastern States in the way of trust companies and State banks, which, under the advantageous laws of the different States, are becoming a successful form of investment. It is but a short time since nearly all the trust companies in New York State were located in the city of New York. Now we find them gradually being organized in smaller places, and new ones are being started in different sections of the State.

I might enumerate many other channels for investment that are opening up in the East, which will become more and more prominent as time goes on. In these latter fields for investment there will be less loss and more safety for capital, for men will exercise greater care and make more thorough investigation before putting their money into these enterprises, as the returns upon their investments will not be as large as in the early days, and they will not feel like employing their principal for a moderate return without making sure that it is perfectly safe. In the early days of Western investments men fought and died in the protection of their enterprises, and it was necessary, perhaps, for them to do so, for what they held was their own; but now the investor, especially if he invests his money in the East in new projects, will be able to go carefully over the ground, weigh the character of the men who are carrying on each enterprise, and thoroughly understand the situation, before putting his money into it.

This country was never in a safer condition than to-day, and if, as I stated before, when Congress assembles, it will immediately repeal the Sherman Act, in the opinion of our best financiers we will then return to a period of prolonged prosperity.



THREE REPRESENTATIVE PAPER-MILLS IN WISCONSIN.

Mill at Combined Locks.

Talulah Mills, Appleton.

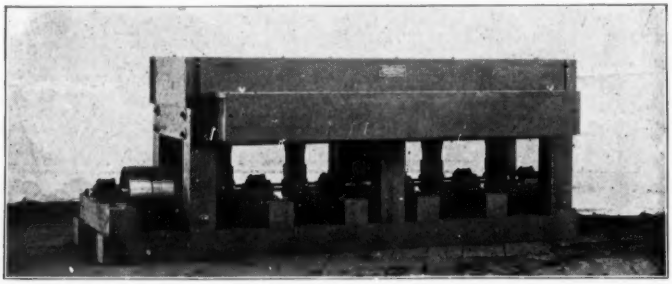
Kimberly & Clark Paper Co., Kimberly.

MAKING NEWS PAPER FROM WOOD.

By G. B. Hanford.

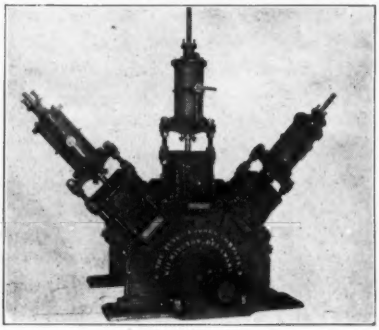
THE measure of the intelligence of a people has come to be determined, in these days, by the extent of its reading. Whatever tends, therefore, to increase the opportunities for the reading habit may be regarded as advancing the progress of civilization and the betterment of the race. The cheapening of the cost of paper has had a marked influence in this direction, and may justly be claimed to be one of the most important contributions of mechanical art to modern advancement.

It was during the war of the rebellion, when the prices of so many of the necessaries of life rose to a point almost beyond the reach of the masses, that the paper-manufacturers, in their search for cheap materials, first began to substitute paper "stock" made from wood for the product of rags. The use of wood-fiber was limited at first by the fact that all the processes were patented, and by the slow progress of knowledge in the use of the new material. Within a comparatively recent period a radical revolution has been wrought in the paper-making industry, which, instead of depending upon a waste product—rags—for raw material, now finds the needed material in the best paying form in pulp wood of various kinds, which have never been through any process of manufacture. This new grade of paper was first produced in large quantities for the newspaper presses, the reduction in cost enabling publishers to put down the prices of their daily issues, until now the poorest wage-earner is able generally to buy both a morning and an afternoon journal without feeling the price to be a burden. The opportunity thus offered to every voter to keep fully informed in regard to current topics of political moment, and to study the trend of affairs with regard to labor and capital, and of business changes far and near, cannot fail in the end to make this the best-informed and most self-reliant and independent people in the world. The use of wood-pulp paper is no longer confined to newspaper offices, however, but is utilized in the making of books and for a thousand-and-one other uses which have been found for paper since it has become such a marvel of cheapness as a commodity. The Census figures and other data on the subject indicate that millions of dol-



A PULP SCREEN.

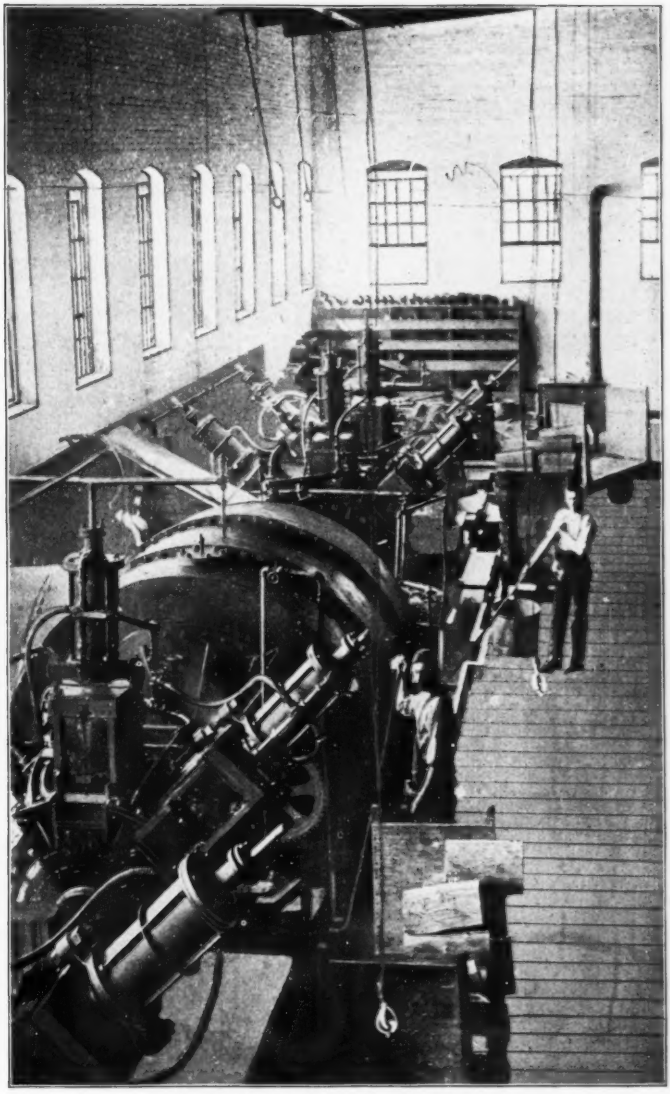
A PULP-WOOD BARKER.



A PULP-WOOD GRINDER.

lars are being invested in new paper-making plants every year. Meanwhile there is a constant increase in the output per horse-power and for each dollar expended for labor. The cost of production is now scarcely one-third of what it was eight or ten years ago, the chief factor in the change being the development in the manufacture of ground wood-pulp.

Probably the best wood for the manufacture of ground wood-pulp is the spruce, found in many of the Northern States and Canada. Desirable sizes of trees are those varying from seven to eighteen inches in diameter, which must be of good, sound growth and are cut into lengths of from sixteen to forty eight inches, varying with the size of the



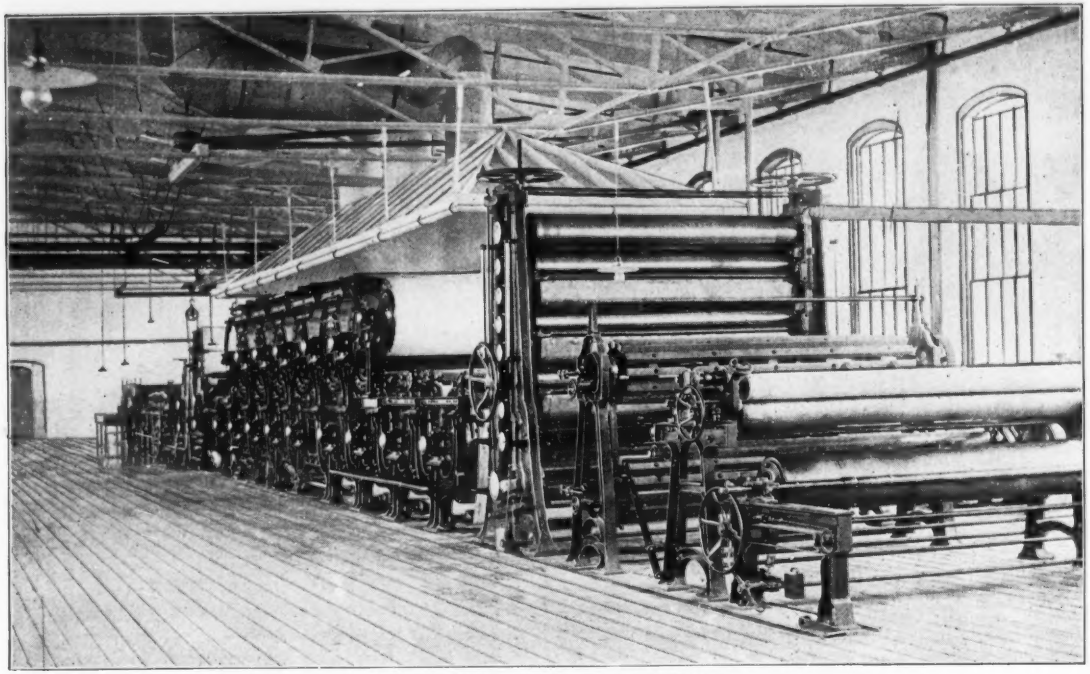
GRINDER-ROOM, GLENS FALLS PAPER COMPANY.

[Showing Grinders coupled direct on Water-wheel Shaft.]

SULPHITE FIBER MILL, MANUFACTURING INVESTMENT COMPANY, APPLETON, WIS.

"grinders" in different mills. The first process, after reaching the mills, introduces the "barker," which removes all the outer bark. The block of wood is placed upon two iron brackets, shown in an accompanying engraving, when the flat disk of iron revolves against it, the sharp knives cutting off the bark which passes through the slit in the disk, in the same manner in which shavings leave a carpenter's plane. The back of the disk is so constructed as to serve as a fan, throwing the pieces of bark into a pipe, to be conveyed as a rule under some boiler to be used as fuel.

The block of wood is now ready for the "grinder," a grindstone of superior quality, sometimes as much as twenty-four inches in thickness, suspended on a large steel shaft and revolving with perfect accuracy. This stone is covered with a cast-iron hood, in the outer rim of which are placed cast-iron boxes fitted with square pistons, which by means of hydraulic pressure force the blocks of wood against the stone, water being introduced in such a manner as to keep the wood from burning as the grinder revolves. In the most approved mill-construction the water-wheel and grinder are on the same shaft; in some mills several grinders are on one shaft, with the water-wheel in the center of the group, as can be seen in the illustration of the Glens Falls Pulp Company's plant, shown in one of the illustrations. Still other mill-



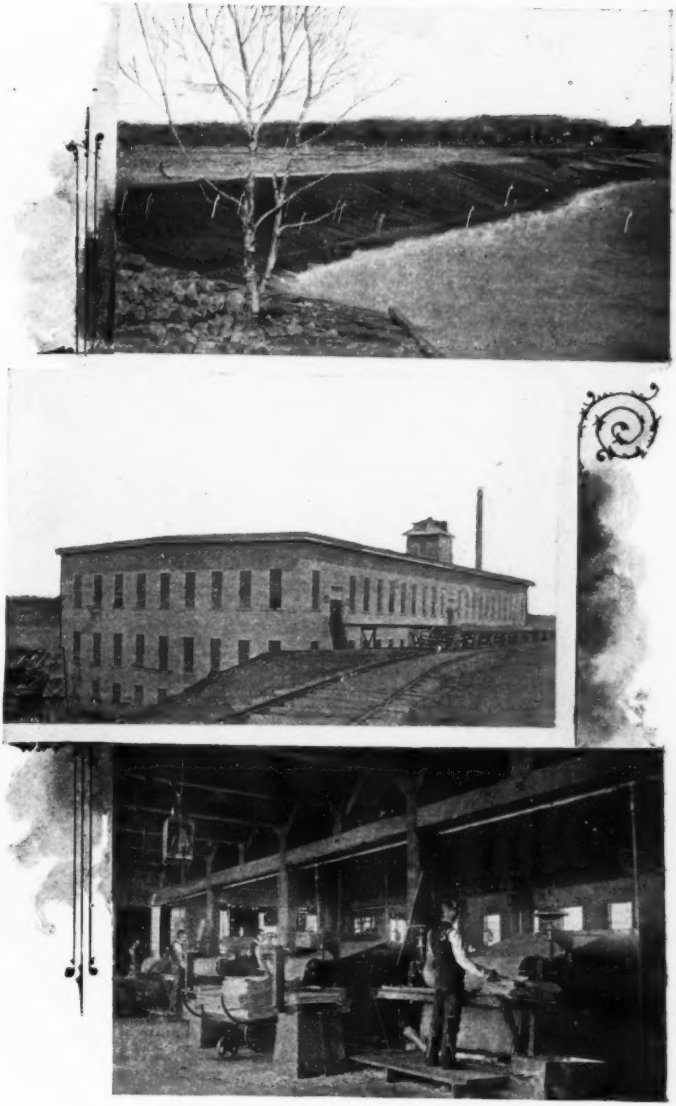
TICONDEROGA (N. Y.) PAPER AND PULP COMPANY'S PLANT.

[Showing 102-inch News Paper Machine. The pulp is fed at the left end and comes out at the right in an immense roll of dry paper.]

operators have thought best to give each grinder its own wheel, making each machine an independent plant. There are strong advocates for both ideas as there are for the various makes of "grinders," in all of which, however, the result is practically the same, even though construction and machinery may differ.

After the blocks of wood are ground into pulp, the wood-fiber thus produced is allowed to run down, and is caught in a screen which takes out the coarse particles. The shaft as shown in the illustration of the screen operates a series of eccentrics, on which are rods with wooden boxes, lubricated with water. These rods in operating up and down move a bellows-bottom, causing a vacuum in the box or vat, which sucks through the fine pulp, as it is poured in on top, on to brass plates perforated with fine holes. After passing through the screen the pulp, as a very fine liquid, is as the rule pumped upon a "wet-machine," where it is gathered upon the face of a woolen felt or blanket, and pressed into layers or "laps," as termed by the trade. These "laps" are folded up into compact shape, and piled on each other, until a bundle is formed weighing a hundred pounds, being one-third pulp and two-thirds water, it never having been found practicable commercially to press out all the water. In some mills the proportion of water in each hundred-pound bundle of pulp has been reduced to nearly one-half, the advantage gained being a saving in freight, when the pulp is shipped to a paper-mill not directly connected with the pulp-mill. Large paper-making plants as the rule grind their own pulp, and in many instances pump it directly into the mixing "engines," thus saving all expense of maintaining and operating "wet-machines," and pressing into "laps." In the illustration of the "wet-machine" room, in the Piscataquis Falls Pulp and Paper Company's mill, men can be seen at work, removing the laps of pulp, as they are formed on the machines. The extensive mills of this company use the entire run of the Penobscot river for power, operating twelve "grinders," producing daily forty tons of dry weight of pulp.

Roughly estimating, it can be stated that a cord of good, sound, spruce wood will produce a ton of dry-weight ground wood pulp. About 200 horse-power are required in grinding three tons of ground wood-pulp in twenty-four hours, the figures varying of course with the quality of wood and kind of machinery used. The development of this class of machinery has been very great, and some of the most competent inventors and designers in this country have devoted a great deal of time to perfecting it.



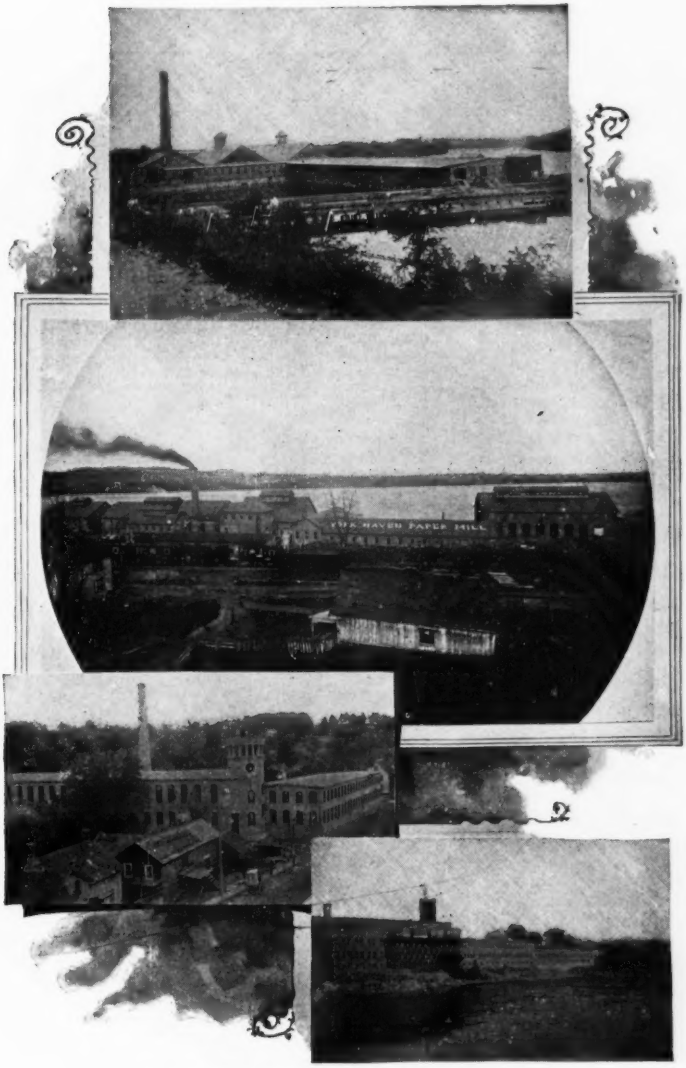
PISCATAQUIS FALLS (MAINE) PULP AND PAPER CO.

[1. Dam—Penobscot River; 2. Building; 3. Wet-Machine Room.

Until recently it was thought necessary to use a number of articles, such as cotton-waste, jute, flax, rags, and other like fibers in order to produce a satisfactory news paper, and while there are large mills still using these articles, the best and most modern mills have entirely discontinued their use, and in their stead have introduced what is known as sulphite fiber, which is a kind of wood-pulp or fiber produced chemically by boiling the wood in a large boiler or "digester," with the proper proportions of steam and product of sulphur. In this way the fibers are disintegrated instead of being rubbed and pulled apart, as in the grinding process, and their full strength is retained. Experiments show that with the proper percentage of sulphite fiber, rags and similar fibers can be dispensed with entirely and a thoroughly satisfactory news paper manufactured for running on modern printing-presses. The manufacture of sulphite fiber cannot be carried on in a small way; in order to make it profitable, substantial and extensive buildings are required, equipped with the very best machinery, made specially for the purpose. The illustration of the plants of the Manufacturing Investment Company's mills shows examples of the largest plants in this country devoted entirely to the manufacture of sulphite fiber. The daily product of this company's two mills is more than 100,000 pounds of dry-weight fiber, ready for market.

After the log we have been following through the various processes has been converted into pulp, and it is at last delivered to the paper-mill, in "laps"—or in the liquid form, when the pulp is manufactured in the mill and pumped—the process begins of making the wood-pulp, combined with sulphite, into paper. The first thing to determine is the percentage of each to be used, the paper-maker having determined this by his knowledge of the use to which the finished paper is to be put. The two kinds of wood fibers are then placed in an "engine"—a large oblong tub, in which the fibers are thoroughly mixed—and after being properly colored and "sized" the mixture, called "half-stock," is passed along through various pipes and vats until it at last appears on a screen in the machine-room. This second screening is necessary in order to remove any particles which may have fallen into the stock as it was passing through the different processes described.

The most interesting feature in a paper-mill is the machine on which the paper is actually made, and it is here that the greatest improvements in the entire industry can be best seen. These machines are rated at so many inches wide. Not many years ago a



MILLS AT FORT EDWARD, N. Y.—DAILY CAPACITY FIFTY TONS.
MILLS AT YORK HAVEN, PA.
ISLAND MILL—TICONDEROGA (N. Y.) PULP AND PAPER CO.
THE NEW SULPHITE MILLS, MADISON, ME.

HYDRAULIC TRAVELING CRANE USED IN THE WOOD-PULP MILL OF THE MANUFACTURING INVESTMENT CO., MADISON, ME.

machine of eighty or ninety inches was considered a wide machine, and there were very few over one hundred inches in width. To-day news-paper machines are seldom less than one hundred inches, and there are some as wide as 140 inches. As machines have grown in width, so have they increased in their weight and stability, enabling the paper-maker to increase the speed from the old-time rate of 125 feet running paper per minute, to more than 300 feet.

The 102-inch machine in the mills of the Ticonderoga Pulp and Paper Company is as good an example of the modern paper-machine as can be found. This machine can run 300 feet of paper per minute and produce in finished paper an average of sixty tons per week. In these mills the ground wood is pumped into the mixing engines and delivered to the machine in such a short time that if the actual log reduced to pulp could be followed through the various processes, it would be found that hardly one hour intervened between the beginning and the delivery of finished paper from the end of the machine, ready for shipping and use on a printing-press. From the screen on the machine, the web of paper passes through the various stages of formation into a sheet of paper, until it is delivered to the finishing-room, where it is wrapped in either rolls or bundles ready for market.

The news-paper business has passed through several stages, the first great change taking place, as already stated, when the mills began substituting wood fibers for rag-stock. At that time the mill-owners found themselves with large plants and extensive mills, equipped with machinery poorly adapted for the use of wood fibers. In the transition that then took place the idea seemed to be that anything would answer in the way of a building, so long as the machinery provided was good. This condition of affairs lasted for a few years, but to-day the successful mill is built in the most substantial and thorough manner. Brick and stone are in every possible place being used in place of wood, and a special effort is being made to erect buildings as nearly fire-proof as possible and to add every known means for saving time and labor in the handling of raw and finished products. We think it can be truthfully stated that in no branch of manufacturing are the mills superior to those being erected by the paper-making companies; and this grand improvement is not the result of the paper-maker's efforts alone, but the architect, the builder of machinery, and the expert insurance inspector have each in turn brought influences to bear, which have led to the building of the modern paper-mill.

THE COTTON-SEED OIL INDUSTRY.

By Erwin W. Thompson, M. Am. Soc. M. E.

THE first experiments in expressing oil from cotton-seed, some sixty years ago, were not looked upon as being of value to commerce, the product finding no general or well-defined use. The substitution of hydraulic presses for the crude wine-press gave an impetus to the industry, which has grown, together with the discovery of new uses for cotton-seed oil, until it gives employment to many millions of capital, and has created great wealth out of what was formerly a waste, if not a nuisance, on the plantations of the South. Not only is the expressed oil of great commercial value, but even the hulls remaining find profitable uses for many purposes. The gradual development of this business may be passed over until the period is reached of its comparatively recent development on an immense scale.

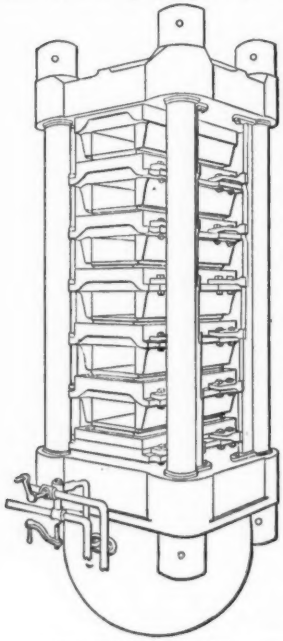


FIG. 1.—OLD-STYLE PRESS.

At first cotton-seed oil was tried as a substitute for all the more expensive oils. It is intermediate between the "drying" and "non-drying" oils, so that it is difficult to substitute it for linseed-oil, which should dry quickly, and still more difficult to adapt it for lubrication, where a perfect non-drying oil is required. By different processes of refining and manipulating it succeeded in a small way in both of these fields, but its greatest success was at first as a substitute for, or adulterant of, olive-oil. In 1872 the production of cotton-seed oil in the United States was 2,250,000 gallons, half of which was exported, mostly in a crude state, to Italy, France, and Spain, where it was refined and made into "olive-oil."

The business flourished on this demand until 1880, when the production was 10,000,000 and the export 7,000,000 gallons. Olive-growing countries, becoming alarmed at the extent of the cotton-oil trade, levied heavy duties upon this product and thus for a time depressed the business, reducing our exports for the fiscal year of 1882-3 to less than 500,000 gallons, though the production had grown steadily up to 19,000,000 gallons.

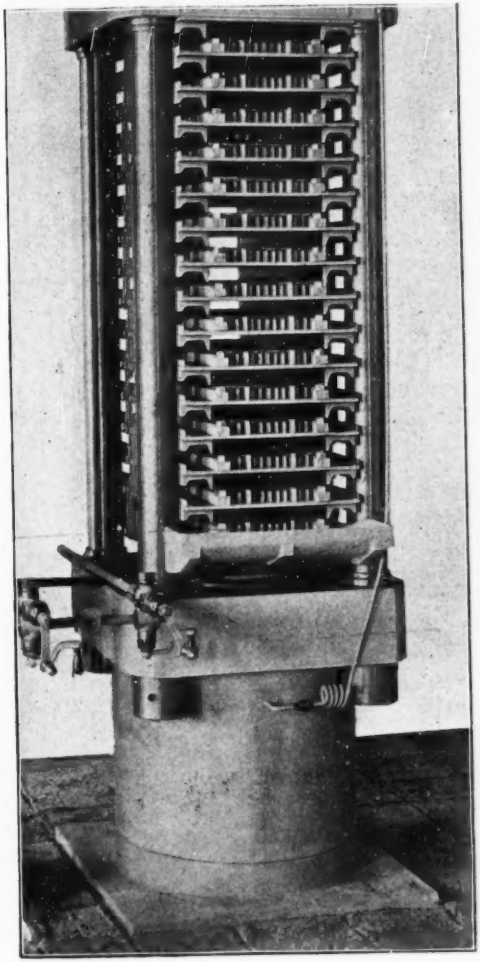


FIG. 2.—A LATE FORM OF STEEL-PLATE PRESS.

Meanwhile the art of refining had grown in this country, and the attention of Americans was called to the purity and sweetness of refined oil, and a demand began to grow for it as a substitute for lard in cooking. Its use for this purpose doubtless would have had an enormous growth, but for the fact of its emitting a disagreeable odor while frying. At about 400° F. the oil seems to break up and the cell-walls appear

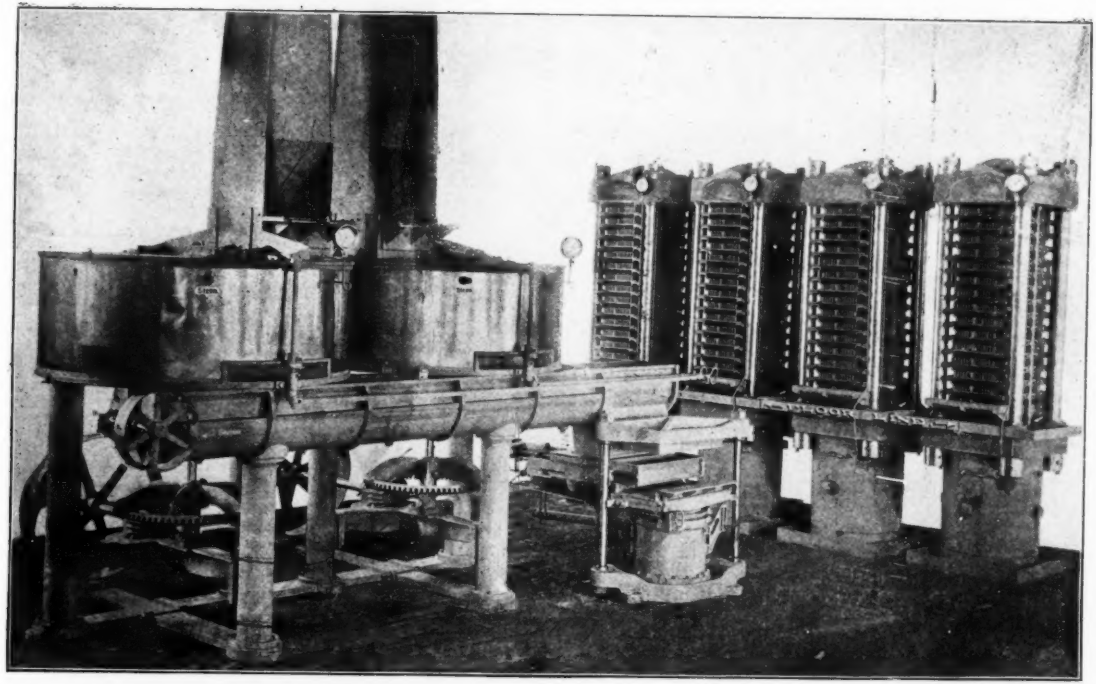


FIG. 3—COTTON-SEED OIL MACHINERY—HEATERS, FORMERS AND PRESSES.

to carbonize. It is not well understood just what form of reaction does take place to produce this odor, and hence no method of perfect deodorization has been devised.

Refined cotton-oil is still used in Europe for adulterating olive-oil, and also used in the pure state as a substitute by the poorer classes in southern Europe. It is used in Holland in the manufacture of butter and cheese, and in America in the manufacture of butter substitutes. It is largely used in all countries for soap-making, one of the most widely-advertised brands of soap containing it in large proportions. But the most important use of cotton-oil now is in the manufacture of "refined lard" in the United States. This subject has lately been thoroughly ventilated and advertised by Congressional investigation during the discussion of the "Conger Lard Bill," which was originally introduced to prohibit entirely the adulteration of lard with cotton-oil. It failed in its purpose, and only served to popularize the practice. Stated in a general way, the process of making refined lard consists in pressing the oil out of pure lard and supplying its place with cotton-oil, which is cheaper than the lard oil replaced. Oil is expressed from the caul fat of beef, and the residue, known as "oleo-stearine," is mixed with the above compound to make it firm and to bring up its specific gravity and melting-point to those of pure lard. Cotton-oil generally enters into the compound to the extent of 40 per cent. The United States Department of Agriculture has taken up the subject of lard compounds under the general head of "Food and Food Adulterations," and a most careful review of the work done in this line, with a full discussion of the physical and chemical properties of lard, cotton-oil, and other substances used in the compounds, has been published.*

The Southeastern States, notably Georgia and South Carolina, have led in mill-building, so that there are now no cities of importance in this part of the cotton-belt without oil-mills; yet not quite half the seed produced in these States is manufactured. The mills compete for seed, not only with each other, but with those farmers, remote from transportation facilities, who use their seed for fertilizers rather than incur the expense of taking seed to market and bringing back commercial fertilizers. This use of seed must eventually be abandoned on account of its wastefulness. Chemical analysis shows that the seed contains the elements recognized as valuable for fertilizing only in small amounts and im-

*Bulletin of the Department of Agriculture, No. 13, 1889.

proper proportions. Manufactured products from a ton of seed are worth about $20, while the fertilizing value of the seed, measured by the price of commercial fertilizers mixed in proper proportions, is not more than $8.

For two years past Texas has taken the lead in mill-building, and there is yet quite a field in that State for new mills. Texas raises annually about 2,000,000 bales of cotton, representing 1,000,000 tons of seed, but her mills have never yet crushed 300,000 tons. The surplus seed is consumed by cattle and sheep, which is a very wasteful way to use it, since there is too large a proportion of oil in the seed for a proper food, and the oil is too valuable for other purposes. The question of cattle-feeding, which is all-important in the Southwest, has undergone a change in recent years, which operates in a two-fold way to the advantage of the oil business. It has been discovered that a combination of the hulls taken from the seed in the oil-mill, and the meal or cake left after the oil is expressed, makes a much better feed than the original seed. Thus the demand for seed for feeding has diminished, leaving the seed for the mills, and the demand for the mill products has increased. When the chemical constituents of the materials are considered, it is a matter for wonder that this rational arrangement has been so long in developing.

Chemical analysis shows that neither cotton-seed, cotton-seed meal, nor hulls have the proper composition for a perfect feed-stuff. Cotton-seed contains about 22 per cent. each of fat, crude protein, crude fiber, and non-nitrogenous extractive matter (these last two items are considered as carbohydrates), giving a nutritive ratio of about 1 to 4½, and having a large excess of fat, which cannot be assimilated by the animal. Cotton-seed meal contains about 45 per cent. protein (nearly all of which is digestible), 10 to 15 per cent. fat, and 25 per cent. carbohydrates. Protein, then, the most expensive of all feed-stuffs, constitutes about half of the digestible constituents of cotton-seed meal, thus rendering it relatively expensive, and too "rich" for the health of the animal. Cotton-seed hulls contain about 40 per cent. each of crude fiber and non-nitrogenous extractive matter, 1 to 2 per cent. fat, and 4 per cent. protein. These constituents are not so easily digestible in hulls as in meal, only about half of the carbohydrates and one-fourth of the fat and protein being digestible. This makes the nutritive ratio for hulls about 1 to 40. The percentage of protein and fat being high in meal and low in hulls, while the reverse is true in regard

to carbohydrates, the mixture of these two products to make a perfect feed naturally suggests itself. Thousands of cattle are now being fattened on this mixture alone, the average feed per day being about five pounds of meal and twenty-five pounds of hulls, at a cost, at current prices, of less than 8½ cents per day. It can readily be seen how much cheaper this is than any other feed-stuff on the market.

The fattening of cattle on cotton-seed hulls and meal on a large scale dates from 1886, from experiments in Texas. Several oil-mills have gone into the cattle business, so that now it is an industry of great importance in all Western oil-mill districts, and 80,000 to 100,000 cattle are now fattened annually in the West on this food. The feeding business has not taken the hold in the Southeast that its importance demands. When it is considered that in the Carolinas, Georgia, and Alabama there are annually produced enough cotton-seed hulls to fatten 150,000 head of cattle, making the finest quality of beef, it is surprising to note throughout these States the great scarcity of native beef of even moderate quality. The leading hotels serve Western beef, a large proportion of which has been fattened on cotton-seed hulls and meal, slaughtered in the West, and shipped at considerable expense in refrigerator cars. Within the last two years dairymen in the Southeast have been using hulls and meal with great success, and nearly all the mills in the country are now easily able to dispose of their entire production of hulls during the months when native grasses are scarce.

Five years ago 90 per cent. of the mills burned their hulls for fuel, and, in cases where there was an excess, it was something of a problem to get them out of the way. One ton of hulls in the loose state, as they come from the mill, occupies a space of 250 to 300 cubic feet, so it will be seen that any surplus would soon become a nuisance. In the sort of mill in vogue at that time there was not any great surplus to consider, because, in common with other crude engineering features of these mills, there prevailed the most wasteful methods of making and using steam. The steam-plant has been the last part to receive engineering attention. All other features of oil-milling were greatly improved and modernized, while the old-fashioned engines held their own during the period when many other factories in the South were being supplied with high-type engines.

The waste product of the oil-mill, like that of many manufactures, now assumes great importance, and has led to the adoption

in all modern mills, and many old ones, of the best steam-plant attainable. At present the cost of coal in the best practice does not exceed 40 to 50 cents per ton of seed worked in small mills, while mills having a capacity of a hundred tons or more easily reduce it to 25 cents. The value of hulls for fuel is only one-third that of coal, so that, when coal is $3 per ton, hulls for fuel are worth only $1 per ton. Hulls now sell readily at $2 to $3 per ton at the mills; and, as they constituted half the weight of the seed worked, there is a new profit added to oil-milling equal in some cases to $1.25 per ton of seed worked. This profit will be increased as the real value of hulls for feed-stuff becomes more generally known, and as the method for caring for hulls is improved by the mills. Most mills are now building storage for hulls, because in the loose state they occupy too much space to be easily handled. Lately there has been placed on the market a very good machine for packing hulls into 200-pound sacks, which renders the handling of hulls as easy as that of hay.

While the new demand for hulls was apparently adding to the profits of the business, increasing competition by the building of new mills was constantly reducing the price of oil and enhancing the price of seed. Left to these influences alone, the latter would easily have prevailed to the extent of bankrupting the business, had the mechanical features of the mills been left unimproved. Twenty years ago the cost in labor, repairs, and incidentals was from $5 to $7 per ton of seed worked. It is true that then mills made enormous profits, but these were made on account of the high price of oil and low price of seed, and in spite of the worst possible mechanical conditions. In a modern mill the total cost of working a ton of seed should not exceed $3.

The earliest form of hydraulic press used in oil-mills was vertical, containing five boxes or compartments about 9 by 20 inches for receiving the prepared kernels which were in bags and enclosed still further in horse-hair "mats" or books. Figure 1 shows this form of press. The next step was in substituting steel for horse-hair mats, whereby the space occupied was so reduced in thickness that two bags might be placed in one box, doubling the capacity of each press. Many presses of this pattern are still in use, but all the modern mills are now equipped with the steel-plate presses shown in Figure 2. This press has fifteen plates corresponding to the five boxes of the earlier presses, and the top of the press stands only a few inches higher from the floor than the box-press, or about

as high as a man can reach. Each plate makes a cake about 14 by 30 inches, weighing, after the oil is expressed, about twelve pounds. The capacity of this press as compared to the old five-box press is as 180 to 35. This press will obtain 40 gallons oil per ton, while the old press obtained only 30 to 35. It was the practice when box-presses were used to have one cooking heater for each press, while now one large heater usually suffices for two plate presses. The modern heaters therefore require only one-tenth the room besides saving considerable steam in the jackets, and saving power in the driving.

With the introduction of the plate press came the "former" shown in the right center of Figure 3. This machine compresses the prepared kernels into cakes thin enough to go between the plates, being a sort of supplementary press. It was at first operated by cranks and belt-power, but finally resolved itself into a direct-acting steam-press. With few exceptions hydraulic presses in oil-mills are operated by plunger pumps. They were formerly driven by belts, but the independent steam-pump has prevailed largely of late. It has the same objection in matter of steam economy, and the same compensating features in the way of reliability, as the steam-"former."

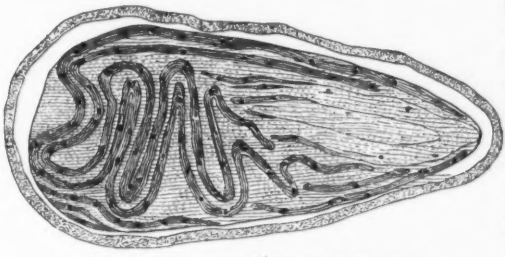


FIG. 4.—LONGITUDINAL SECTION OF COTTON-SEED.

It is the popular impression that the operation of an oil-mill consists of putting the seed into the presses and extracting the oil, but there is considerable preliminary work of prime importance before the presses are reached,—important both in its bearing on the final process of extracting the oil and in its production of by-products.

Figure 4 is a longitudinal section of a cotton-seed, magnified ten diameters. It shows the outer hull with the fiber removed, and, within, the convoluted embryo, containing the oil-cells, indicated by black spots. In the milling process the seeds are first cleaned by revolving screens. "Linters," shown in Figure 5, are machines similar in principle to the cotton-gin. They remove

some of the lint cotton which will adhere to the seed, in spite of the most careful ginning. From the linting-machines the seed pass to the hulling-machine shown in Figure 6, which consists of a cylinder covered with knives revolving at a high speed in a case lined with stationary knives. This cuts the seed into small bits, which are conveyed to the revolving screens designed to separate hull from kernel. The kernels go to the crushing-rolls.

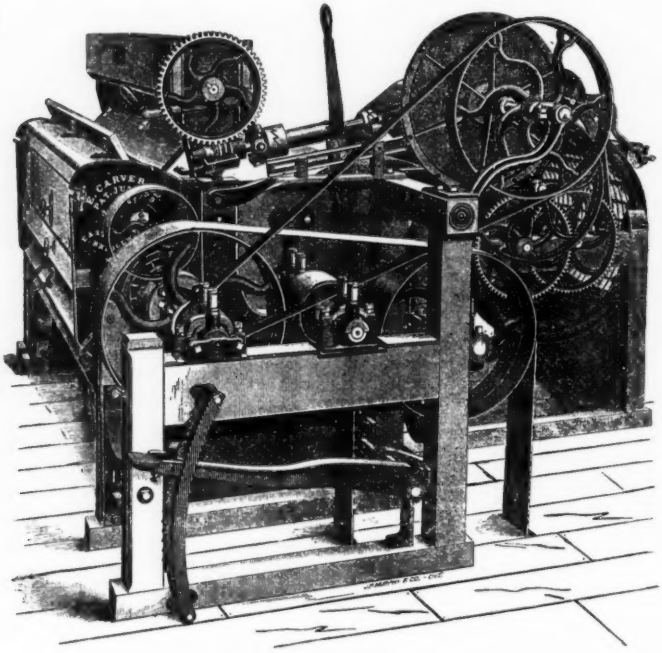


FIG. 5.—LINTING MACHINE.

The next process is cooking, which is accomplished in the most modern mills by the heater apparatus shown at the left of Figure 3. It usually takes about twenty minutes to cook an ordinary charge of 500 to 600 pounds of crushed kernels. When the cooking is complete, the material has reached a temperature of 220° F. It is drawn out into a steam-jacketed conveyor, which delivers it to the "former." This machine prepares it for the presses. Hydraulic pressure is kept on the cakes from twenty to thirty minutes.

The oil runs out into troughs, thence to tanks under the floor, from which it is pumped to the storage tanks or to the refinery.

The cakes, left after the oil is expressed, are sometimes ground into fine meal and sometimes left whole for export to England and Scotland, where they are coarsely ground or broken up for feeding sheep and cattle. The other extreme is reached in Germany, where the demand is largely for the finest meal that can be produced. Cake-grinding in the present type of oil-mill is the feature most susceptible of improvement. The cake is first cracked up into small pieces by some form of machine similar to that shown in Figure 7. The cracked pieces go either to an ordinary set of buhr-stones, or to some of the various sorts of iron grinders, or in some few mills to regular wheat rollers.

Heretofore Southeastern mills have been able to dispose of their entire output of meal in local markets, for a fertilizer, and for mixing with other ingredients to make fertilizers. At present it is necessary for all large interior mills to look to the export trade to care for the surplus cake and meal.

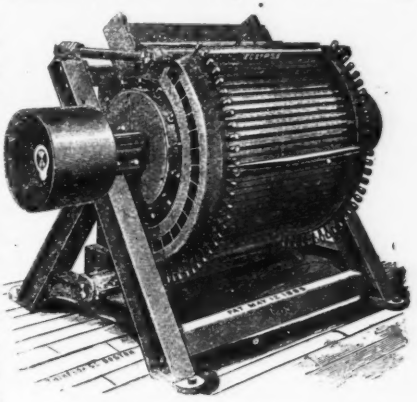


FIG. 6.—COTTON-SEED HULLER.

The present system of pressing leaves 10 per cent. of oil in the cake, and it entails a heavy outlay for machinery. Hence it would seem, theoretically, that the most logical way to extract oil would be by some process in which the seed, after being ground, would be completely exhausted by an oil solvent, which could be easily distilled off and used again. This would give a great impetus to plantation mill-building, which has heretofore proved unprofitable, but which, more especially since the recent advance in stock feeding, would become very important were oil-milling more simple and inexpensive. As yet no solvent has been a commercial success. It has been principally due to the difficulty of removing from the oil the odor of the solvent, which has generally been some light petroleum.

Refining cotton-oil is a chemical process that has not received enough intelligent attention. As now practised it is a very simple but a wasteful process. It consists in bleaching to a bright yellow the crude oil, which is of light brown color, and the neutralizing of the free fatty acids by means of agitating and heating with a solution of caustic soda. The free fatty acids in prime crude oil do not exceed 1 per cent., and the coloring matter half of 1 per cent. The loss in refining, therefore, should not exceed 2 per cent. As a matter of fact, however, the loss, in present practice, averages 8 per cent. for prime oil. This loss is due to partial saponification,

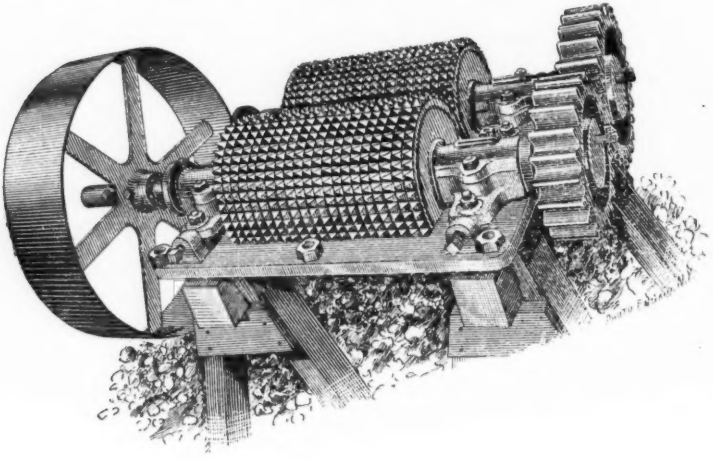


FIG. 7.—COTTON-SEED CAKE CRACKER.

which is found to be necessary to precipitate the coloring matter. The residue, called "soap stock," is not a total loss, since it contains about 60 per cent. of fatty acids and is used in the manufacture of soap. It sells for about 1 cent per pound. It would be worth three times this amount if some cheap process were to be discovered for recovering the coloring matter for use as a dye-stuff, instead of wasting it, as is now done in soap factories.

Early in the history of this industry it was recognized that some sort of association of mill-owners would be profitable. At a meeting in New Orleans in 1876, twenty mills were represented. From that time one form of organization after another was tried, until, in

1885, the American Cotton-Oil Trust—now known by different names in different States—was gotten up by the leading manufacturers, with the Standard Oil Trust as a model. The methods of its petroleum prototype were pursued so successfully that within two years nearly all the desirable mills and refineries in the country had been forced into the combination, exchanging their stock for Trust certificates. It became a very profitable arrangement, some $42,000,000 of Trust certificates outstanding to represent plants not intrinsically worth $3,000,000, but, by virtue of established business and the fair prospect of monopolizing the trade, ranging from 60 to 70 points on the Stock Exchange. To this Trust is due the reduction of the oil business to a uniform system of operating and accounting, handling the products, and introducing them into more general use. The success of the Trust discouraged mill-building for a while, but in the spring of 1887 three large mill-operators left the combination and organized the Southern Cotton-Oil Company, with $5,000,000 capital, which, by the opening of the oil-making season, had built and equipped eight new mills with a daily capacity of 1600 tons of cotton-seed. Opposition to the Trust having been demonstrated to be feasible, a new impetus was given to the industry, no fewer than thirty new mills coming into existence in 1889. On the whole the new mills are taking a stand as successful enterprises, independent of the two combinations above named, and occupy a distinct and well-recognized position in the oil business, while additions to the number are made each year.

PRACTICAL HINTS ON HOUSE-HEATING.

By Leicester Allen, A. B., M. E.

IV.—THE CONTRACTOR.

THE contractor for heating and ventilating apparatus occupies a position which, considered with reference to its perplexities, anxieties, responsibilities and risks, is by no means enviable. The owner, the architect and the expert designer of the apparatus, all have their fling at him. If he is so lucky as to get through his job without friction with any of these, there remains the contingency of trouble with the men employed to do the erecting, who may get to drinking and fail him at some critical part of the work; who may incur discharge from incompetency or inefficiency; who may slight some part of the work and conceal the defect until the test of the apparatus discloses the weak point. Or they may be found some morning standing in a group on the sidewalk and refusing to work, by the orders of a walking delegate, because, perhaps, the man who sold the bricks for the building has employed a non-union man to help unload a barge at a dock ten miles away. All through the work, from inception to finish, he will meet with annoyances. He will have, at times, to wait and keep his men waiting for the architect, for the masons, for the carpenters, for the delivery of materials. He will be obliged to use his utmost skill, tact and resolution, to keep the sum of losses resulting from these waits from absorbing the slender margin of profit, at which, under the pressure of active competition, he has ventured to risk undertaking the contract. He will find other contractors for masonwork, carpenter-work, etc., extremely disobliging; they, too, have analogous perplexities and troubles, which soon teach them that, to live, they must look out strictly for "number one," knowing little and caring less how "number two" gets along. Truly the contractor's life is not a bed of roses.

But his own shortcomings must be added to make the category of the contractor's annoyances complete. A great part of the worry that wears more than work is brought upon him through want of care in making estimates, through want of good methods in the purchase of materials, through defective organization in his working force, through inefficient superintendence, through rashness in undertaking contracts, which, by reason of limited capital

and want of proper facilities, he cannot execute with profit; and lastly, through a too frequent lack of that iron-faced integrity that will live up to the very letter and spirit of a contract, as truly when the unwelcome discovery is made that the contract will entail a loss, as it would when a handsome profit is in sight.

First, in estimating and proposing for work, the contractor should make sure that, as a competitor, he will be fairly treated. In a symposium entitled "The Rights of the Lowest Bidder," published in this magazine for January, 1892, I placed in as plain a light as I could the principal phases of this part of the contractor's business. "The Answer of the Law" to the questions I raised in that article, as given in the same number by Mr. Charles E. Hellier, cannot be too carefully perused by contractors. The competing contractor, as is shown by Mr. Hellier, can only secure himself a legal recourse for unfair treatment in competition by a written or verbal preliminary agreement; and this he ought always to have before he spends any time or incurs any expense in making his estimate. Particularly should he obtain, in case he contemplates estimating upon plans and specifications supplied by the architect, the assurance in writing, or verbally in the presence of witnesses, that all who are requested to estimate as competitors for the work, are to estimate on the plans and specifications exactly as presented, and that the contract will be awarded to the lowest competing bidder; and he ought also to know the names of the other competing bidders. If this information be denied him a safe rule for him to follow would be to decline entering into the competition. There is nothing in this course to which an architect who means to deal fairly with those he requests to estimate, should make the slightest objection; it is simply straightforward, honest business, and he who declines it, showing by such a course that he prefers circuitous, ambiguous methods, is not a safe man to deal with.

The contract completed, the next thing in order is to select and purchase the materials required. Most contractors keep much of the necessary materials in stock, but it had to be purchased at some period, and the particular order in which the purchase comes is not important. The important matter is that the materials should be good. The attempt to introduce inferior materials into a heating plant nearly always results in loss to the contractor. The one item of the pipe is a good illustration of the way such attempts recoil upon the contractor. A grade of pipe of brittle, inferior iron may be perhaps purchased at a low figure; but the difference be-

tween its cost and that of pipe manufactured by the best makers and of first-class quality will not nearly compensate for the loss of time entailed in cutting and threading it, the difficulty in making a tight job with such pipe, and the increased wear of tools. Inferior fittings, no matter if purchased at a low price (I had almost said given to the contractor) will in the end cost more than the best.

The same policy of getting the best applies to tools. In rapidity of execution, in the superior quality of work done, in lessened cost of repairs, good tools repay their greater cost as compared with inferior tools many times over. I may as well say here, also, that no work pays a contractor so well as that expended in keeping all his tools in proper condition. It is now the practice of the best steam-fitting establishments, when tools are returned from a job, to overhaul each kit, and immediately repair or sharpen, as the case may require, any tool that is not found to be in good working condition. Another great point in the care of tools is that an exact record of tools in the various tool-chests should be kept, and that the workmen to whom they are intrusted should be held responsible for their safe return to the proper chests at the completion of each job. Moreover, each kit should be complete in itself. The too common practice of lending and borrowing from one kit to another is fruitful of trouble, not only among the workmen themselves but to the superintendents placed over the men. The rule should be that neither borrowing or lending of tools is permitted. If a workman needs a tool not included in his kit, he should apply to the superintendent for it. In case delay in the progress of the work is likely to result from want of such tool, the superintendent can take the tool from any other kit containing it, and after examining its condition can see that it is returned without injury to its proper chest.

The delivery of the necessary materials at the building and their prompt inspection for acceptance or rejection by the architect or his representative, in advance of sending the workmen to commence the work, is another secret of success in contract work. As far as possible, all the materials should either be so delivered, or purchased and stored where they can be promptly delivered when wanted, to avoid keeping men waiting or, if not stopping their work entirely, compelling them to work to disadvantage while waiting for the delivery of something needed to allow the work to proceed in a systematic manner.

Much of the failure to secure anticipated profits on heating contracts results from inefficient superintendence of the men who per-

form the work. In all branches of business success depends greatly upon skill in selection of men for special positions, and without skill in the estimate of fitness for the responsibilities of superintendence, in selecting men for this purpose the contractor is handicapped as compared with other more discerning contractors. Nothing but natural quickness in "sizing up" men, coupled with knowledge of the requirements gained by experience, can give this power of discrimination. A good superintendent should be competent to read and interpret plans and specifications, and to start his men on the work quickly, distributing his force to different parts of the work with definite directions as to what they shall do. He should be able to decide promptly all questions arising during the progress of the work from any change of the plans of the building that may necessitate a change in the position of any part of the apparatus, to judge whether these enforced changes involved any extra material or work in excess of that called for in the original plans and specifications, and, if so, to keep an itemized account of the cost of this extra work, etc., that the contractor may present a valid claim for an extra allowance therefor. He should have force of character that will enable him to control his men and hold them to the strict performance of their duty, coupled with sense of justice, tact, and impartiality that commands their regard, respect and good will. While never demanding anything of the men that is unreasonable, he should gain a reputation for firmness that will deter any of the men under him from making unreasonable demands upon him. He should possess manners that will enable him to impress favorably not only the owner and the architect, but also other men who perhaps drop in casually while the work is in progress with a view to picking up information of value to them in letting out similar contracts. A coarse, offensive, repellant manner in a superintendent has often operated adversely to the interests of his employer. He should be absolutely truthful in his dealings with his employer. Nothing can compensate an employer for the worry of uncertainty resulting from a suspicion that a superintendent is either concealing or misrepresenting facts. For my own part, as a contractor, I would make the first lie about a job on the part of a superintendent the signal for his summary discharge, whether the lie was perpetrated to screen some blunder of his own, or to shield some fault in any of the men directed by him.

The question of whether it is good policy to employ union or non-union men probably will be variously decided by contractors.

I am of the opinion that, notwithstanding the risks of interference by trades-unionism with the progress of work, few heating and ventilating contractors will achieve much success who disregard these organizations. For better or for worse, trades-unions are here to stay! It would be folly to deny that they comprise the most efficient workmen obtainable, and without good workmen the contractor is very like a man with a wooden leg attempting a foot-race.

The superintendent of the work on a contract should be vested with the power to employ and discharge men. An appeal to the contractor, however, from the superintendent's action, should be possible. This is good policy, not so much on account of the facility it affords for preventing acts of injustice to workmen, although this is also important, but because it enables the contractor to judge the better of the methods adopted by his superintendents in dealing with men, and will often afford valuable information as to the progress of the work. A workman, so appealing, should not be met by the contractor with a forbidding aspect, or with a manner that indicates indifference to a claim for justice. He should be received in a way that convinces him he will get a candid and impartial hearing. It may be that only a condition of incompatibility has existed, and that for the sufficient reason that this particular workman and the particular superintendent to which he has been assigned could not get along well together, the superintendent has thought a discontinuance of the association to be advisable. Should this prove to be the case, the contractor may well consider whether the services of an otherwise competent man would not prove valuable under the direction of another superintendent on some other contract, and show his desire for justice by so assigning him. A contractor always gains by the exhibition to workmen of a disposition to be guided by the golden rule—to treat them as a man should treat his fellow-men.

Deviations from plans in building give contractors for heating work much trouble. It not unfrequently happens that changes are made after a building has been commenced; the plans for the heating and ventilating apparatus, based upon the original plans for the building, are thus no longer applicable without change. The contractor finds that some obstruction has been introduced—perhaps several—and that he cannot alter the heating plans and do the work according to the required alterations at the price named in his contract without either reducing his profit, or perhaps even wiping it

out altogether. Such changes are apt to be more frequent in the erection of buildings designed for dwellings than in those of a public character; but it is rare that any building is erected exactly according to the original plans. Either for the correction of some fault developed during the process of erection, or to amend some oversight, such changes are made. The position of a staircase may be changed; doors may be shifted somewhat from the places originally assigned them, or their widths may be altered, etc. The heating contractor may find that, where his plans allowed a free runs for pipes or flues, beams are in the way, and that these cannot be cut with safety to make a passage for the pipes. He may be in this way or other ways forced to run the pipes in a circuitous fashion not anticipated, and compelled to introduce sometimes much more material and labor than he considered in the original estimate. Of course provision has been made in the contract that he shall be paid an extra sum for work of this kind; but it is not always an easy task to make the architect and owner see, or, at least, to get them to acknowledge that they see that more work and material have thus been entailed, and friction results.

The above fitly introduces the subject of extras, as they are commonly called by contractors. It is a common practice for some contractors to estimate low on contracts, in the hope of thus succeeding in competition, relying upon their adroitness in charging for extras, and getting architects to certify to their charges, to eke out the slender profit that would otherwise accrue to them. It is obvious that to do this successfully a contractor must have "a pull" with the architect, or rely upon his ability to obtain such an influence with the architect as will help him out in such a scheme. In this way some discredit has fallen upon the heating contractors' business, and the difficulties of honest contractors in obtaining proper and reasonable allowances for extra work have been increased. The very name "extra allowance" has come to be hateful to architects, because it has been used so often by unscrupulous men as a means of attempted extortion; nevertheless this is and will continue to be a phase of heating-contract work. No matter how smoothly everything has previously gone on a contract, when the time for mentioning extras arrives there is apt to be a cyclone.

The heating contractor will find it necessary to make some concessions. It is better, as a rule, to pocket a small reduction of anticipated profits than to wrangle with owner and architect. Of course there must not be too much concession—that is not busi-

ness; but every wise contractor will look beyond the execution of any particular contract to possible prospective contracts, and will find that a small present sacrifice often brings a large future advantage in good-will and opportunity.

Lastly comes the testing of the work to prove its capacity and demonstrate the absence or presence of imperfect workmanship. As a rule, owners and architects will be better satisfied to have the test performed in cold weather, and there is some foundation for this preference. But the intelligent, conscientious contractor, who can satisfy himself that the plant he has erected is free from imperfect workmanship, and has the necessary capacity, need have little fear that he will satisfy other interested parties. To this end, a test in summer with the temperature at 70° F. can be made as satisfactory as one made in cold weather, except as to the one point of the time necessary to generate steam in the colder apparatus as compared with that required to raise steam when water, boiler, pipes, radiators, and the surrounding air are at nearly a common temperature, this temperature being about the same as that needed to be maintained in the building in winter weather. The temperature of all the environment, except that of the walls (the interior surfaces of which will be colder in winter than in summer), will be the same when the exterior air is 70° F. as when the apparatus is at work and producing this interior temperature in colder weather. Happily, the whole matter is susceptible of computation, if the contractor is up to this kind of work; if not, he should secure the services of a man competent to calculate from the efficiency of the apparatus under one set of conditions, what will be its efficiency when the extreme conditions under which it is guaranteed to work shall have been established. He may then await in peaceful confidence the results of actual service.

SUMMER SUBURBAN COMMUNITIES.

By Charles F. Wingate.

A NOTABLE feature of American social life is the recent growth of cottage settlements at the sea-shore and in the mountains, where city residents may recuperate during the summer with their families and enjoy unconventional outdoor pleasures. The strain of modern life is more and more severely felt, and men, women, and children alike suffer from the deterioration of town life and feel the desire and need of returning to the heart of nature for rest and recreation.

Hitherto the interest of city residents has been concentrated at the sea-shore, and as a result the whole Atlantic coast from Bar Harbor to Barnegat is lined with cottages ranging from the palatial residences of the Vanderbilts at Newport to the humble fishermen's huts at Patchwork village, 'Sconset. But people are at last beginning to realize that seaboard residents need a change to higher altitudes and that fishing and boating and salt-water bathing cannot compete with tonic mountain air in invigorating and building up debilitated minds and bodies. Camps and cottages have long been popular in the Adirondacks, while the White

"REST AWHILE" CABIN, IN THE CATSKILLS.

A COTTAGE IN CAMP COMFORT.

Mountains attract thousands of visitors yearly ; now the sleepy old Catskills are creating a revived interest in the public mind, as if they had just awakened from a twenty-years' nap.

With the growth of popular taste has come a change in methods of summering. Sensible people are no longer satisfied with promenading hotel corridors or lounging and gossiping upon boarding-house piazzas. They shun the excitement and confusion of crowded summer-resorts and prefer seclusion and privacy such as can be obtained only in the home. On the other hand they do not wish to be too isolated or to bear the burdens of housekeeping all through the vacation season. They seek to retain individual freedom and independence with the social advantages of a community, and the result is seen in the different Catskill cottage communities which have been founded in the past five years.

Within a circle of ten miles from the old Mountain House—a famous resort for past generations of Americans—a half-dozen so-called Parks have been laid out since 1887 with a present popula-

tion of over five hundred persons, occupying some four-score cottages and representing an investment of perhaps half a million dollars. The chief attraction of these settlements is the simplicity of the life enjoyed by the people and, secondly, the club feature which has been engrafted upon them. In each community there is a central inn or club house where meals are served and which is also a gathering place and center for social entertainment. The cost of necessary improvements—roads, water-pipes, sewerage, sidewalks, etc.—is borne by the promoters, who are organized on a joint-stock basis, and is repaid by an annual assessment levied upon lot-owners. While these enterprises partake of the nature of a real-estate speculation, great care is exercised in weeding out intending buyers so as to exclude undesirable persons, and the proceeds

STONE CHIMNEY IN A $1200 COTTAGE.

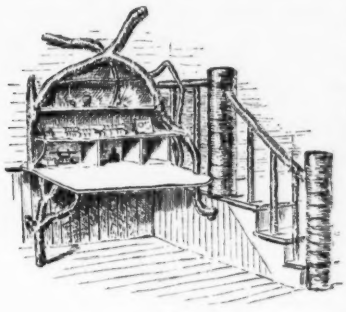
INTERIOR OF A $1200 COTTAGE IN THE CATSKILLS.

from sales are all spent on improvements, which necessarily add to the attractions of the place. The purely mercenary interest being thus made secondary to social needs, the coöperative features have precedence.

In the largest of these parks there is a church, bowling-alley, tennis-court, livery-stable, and even a drug-store where soda-water, candy, and photographs, principally, are sold. There is a large workshop, where much of the building material is prepared for use, and last winter a portable steam saw-mill was engaged in converting trees into boards and joists, with which to construct cottages. There are carpenters, stone-masons, bricklayers, plumbers, painters, and tinsmiths constantly on hand, and building goes on rapidly. A single month sometimes suffices to erect a commodious cottage, and in one instance a seven-room house costing $1200 was put up within nine days.

A CABIN PORCH.

Most of the cottages range in price from $1000 to $1800, but there are many above and below these figures. The simpler and cheaper houses, and particularly the log cabins, are especially popular, and it is surprising how much comfort can be obtained in such dwellings at small cost, say $500 or $600. Sanitary requirements are carefully looked after. The club-houses and larger cottages have modern plumbing appliances of the best quality, connecting with carefully-planned sewers. In most cases,



A RUSTIC DESK.

INTERIOR OF A $500 LOG CABIN, WITH RUSTIC FURNITURE.

A $500 LOG CABIN IN THE CATSKILLS.

however, the earth-closet system is employed, and with careful supervision is bound to give satisfaction. There is an abundant water-supply taken from pure mountain springs, and every house and cabin has running water in it. There is a resident physician who can be called upon in an emergency, though his chief occupation is looking after the ordinary ailments of average humanity in every community. Many delicate and semi-invalid visitors gain great benefit from the tonic air, but the parks are not sanitariums, and sick people are not encouraged to come and dwell there. The chief purpose in view is wholesome living and social relaxation. There is plenty of entertainment at all times in the form of dances, card-parties, amateur plays, and musicales, but the rule is always to cultivate early hours and informality; dress coats, diamonds, and six-button kid gloves are not popular in these places.

In most cases the lots are not sold outright, but a perpetual lease is issued to buyers, similar to those given at Round Island and elsewhere. There are rigid restrictions against the erection of outhouses and stables, the public sale of liquor, and the maintenance of any form of nuisance. Birds, squirrels, and other living creatures must not be injured; fires in the woods and picnicking by outsiders are forbidden, and anything that tends to destroy privacy or deface the landscape is tabooed. There are no dividing fences

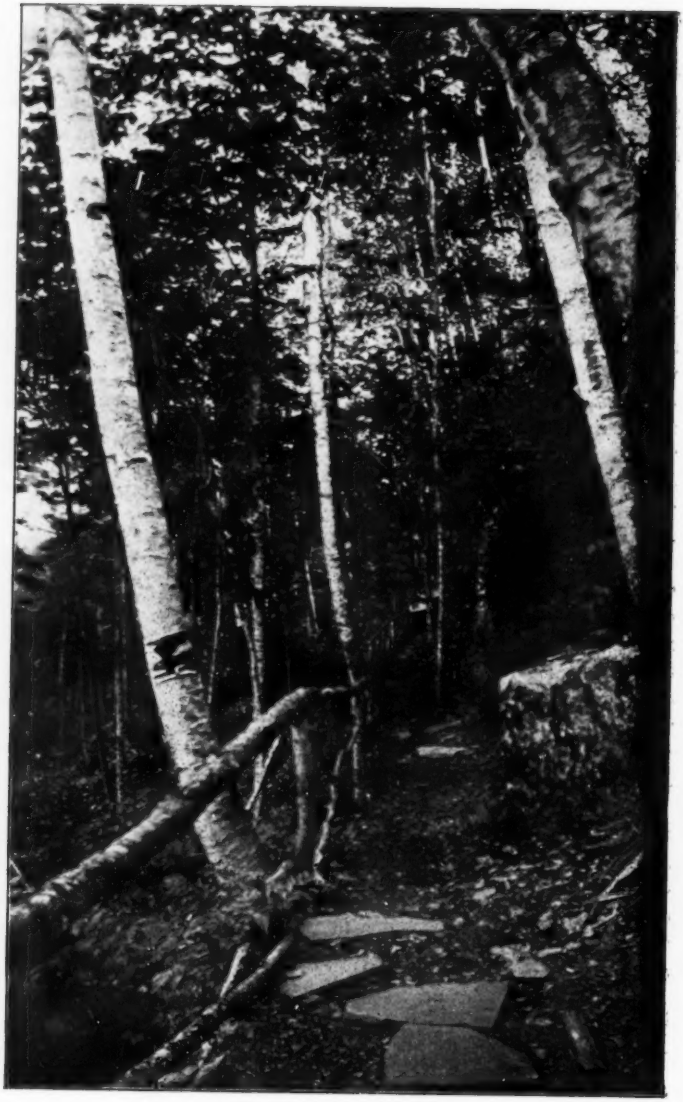
SITTING-ROOM IN THE CLUB-HOUSE AT TWILIGHT PARK.

to prevent people from wandering freely about the park by the foot-paths which, however, are not carried near enough to dwellings to annoy their inmates.

The plan of a typical cottage includes a spacious living-room with an open fireplace of brick or rough stone, round which the occupants gather after nightfall and on rainy days to enjoy the blazing fire of logs. In many cases the fireplace is placed across an angle of the room, and sometimes the stairs are carried over the mantel like a balcony. Under each mantel is inscribed a motto such as—"Loaf and Invite Your Soul," "The Cantie Hearth Where Cronies Meet," or "Fire and Heat, Praise Ye the Lord." The walls are not plastered, but ceiled with hard pine, which takes on a fine rich color with time. The floors are bare and stained, with Turkish rugs scattered about, while broad divans heaped with pillows invite one to lounge indefinitely. The beams above are left exposed to view. Rustic wood-boxes, side-boards, book-shelves, tables, and writing desks are constructed of maple and birch and ornamented with laurel or moose-wood as the owner's taste may suggest. To form closets the corners of bed-rooms are filled with triangular shelves and hung with simple stuffs. Rustic hat-racks are made of hemlock or spruce trees, with their branches trimmed for pegs and the whole varnished. Lastly, very tasteful tables are made by cutting broad planks so as to form a square around a massive birch post, and, when the former is stained

THE PEEP-OF-DAY WINDOW.

CABIN GABLE.



A WALK TO DINNER, BETWEEN COTTAGE AND CLUB-HOUSE.

a rich cherry, the contrast of color is very striking. Some of these manifold devices, which vary according to individual whims, are shown in the accompanying illustrations,—either pen-and-ink sketches or reproductions of photographs. There seems to be no limit to the possibilities of invention in this direction, and the best results are often gained with the least outlay of money.

The club-houses or inns are planned chiefly to supply meals to the cottagers. They have some bed-rooms to accommodate visitors, but boarders are not sought, and the managers are not desirous of running a hotel. Strangers are not admitted without some introduction, and a preference is given to the friends of the cottagers. Going to and from meals is a pleasant change and an inducement to exercise. Even in rainy weather every one turns out. There are flagged walks to many of the houses, and travel is easy. In the dining-room there is no formality. Introductions are hardly necessary, and a newcomer soon feels at home. The season extends usually from June 20 to September 15.

Of the five cottage-communities in the Catskills especially referred to, Onteora (Hills of the Sky) was established by Francis B. Thurber and his sister, Mrs. Candace Wheeler, two miles north of Tannersville on the slope of Parker mountain, with a commanding and sweeping view. It now contains some thirty cottages clustered around Bear and Fox Inn. Twilight Park, adjoining Haines

WINTER VIEW OF A $1000 COTTAGE.

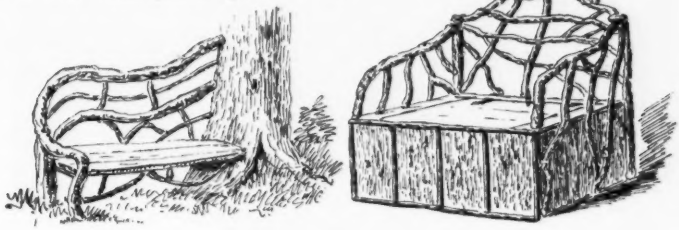
A FAMILY TENTING IN THE CATSKILLS.

Falls, was founded simultaneously in 1887 and is an outgrowth of the Twilight Club of New York, though having no direct connection with the latter. It now contains three club-houses and forty-seven cottages and cabins. Twilight Inn was built in 1891 and Squirrel Inn during the present year. The situation of Twilight Park is notable for its expansive view through the Kaaterskill Clove across the Hudson valley to the distant Berkshire hills. There is a superabundance of rocky ledges, admirably adapted for building sites; water-falls abound and the facilities for drainage are exceptional. Sunset Park adjoins Twilight on the west and Santa Cruz Park on the east.

LOOKING TOWARD SUNRISE.

The former contains eight and the latter six cottages, beside the Lodge. Elka Park, founded by members of the Liederkranz Club, is situated at Mink Hollow, about two miles from Tannersville and facing Onteora. It has a large club-house, which partakes rather of the character of a hotel, and a half-dozen cottages. The Germans do not seem, however, to take as kindly to coöperative experiments as the Anglo-Saxon people.

At Onteora the cottages range in cost from $1000 upwards. A



CHEAP WOOD-BOX AND ROADSIDE SEATS.

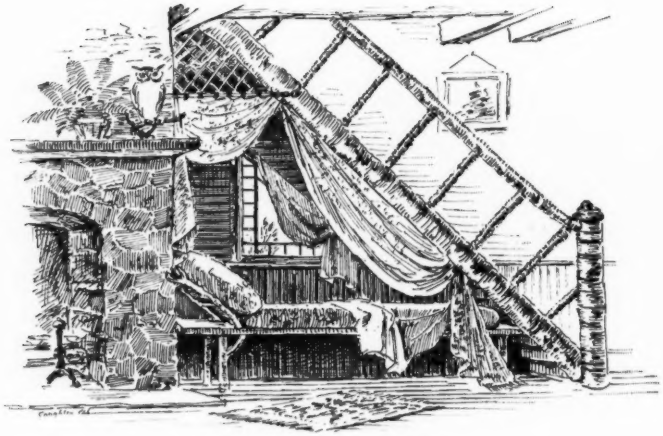
AN ARTIST'S CABIN IN PIKE COUNTY, PENNSYLVANIA.

A $1500 COTTAGE IN THE CATSKILLS.

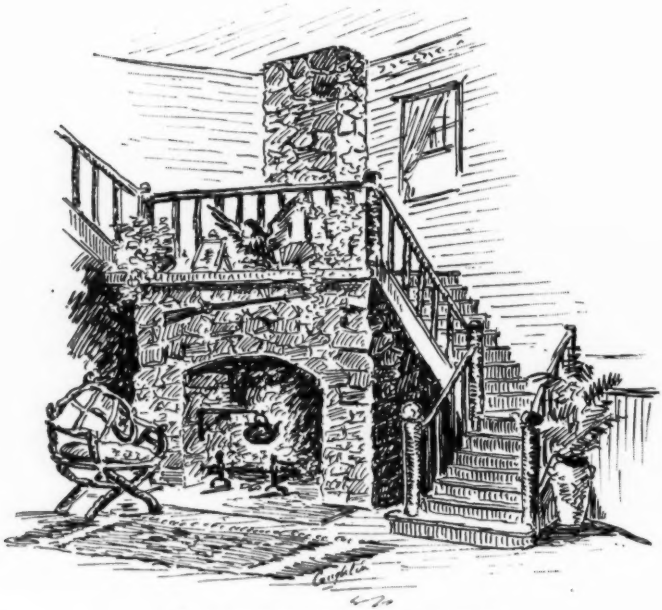
preference is given to houses covered with hemlock slabs and stained in subdued colors to harmonize with their woodland surroundings, as they are mostly set among trees. Rough stone chimneys are the rule, and it is a pleasant custom to decorate the open fire-places with evergreen branches or rich-hued autumnal boughs. The walls in many cases are lined with burlaps, having a fire-proof coating which can be decorated in tasteful fashion. The Bear and Fox Inn is commodious and comfortable, and its quaintness and originality charm every one. Recent buyers have erected more imposing houses in the style of the colonial villa type, but the general tone of rustic simplicity has been preserved from the beginning.

A SNUG NOOK.

Among the cottage-owners at Onteora are Mary Mapes Dodge, Dunham Wheeler, Dora Wheeler Keith, Carroll Beckwith, the artist, Mrs. Schuyler Van Rensselaer, Lawrence Hutton and John



"LOAF AND INVITE YOUR SOUL."



"THE CANTIE HEARTH WHERE CRONIES MEET."

B. Leavitt, while "Mark Twain," Rev. Dr. Heber Newton, Mrs. General Custer and Brander Matthews, have summered there. Twilight Park has less of a purely literary and artistic flavor, but is largely made up of professional men and women, including General George W. Wingate, S. C. T. Dodd, Professor Benjamin E. Smith, Rev. J. Howard Suydam, Rev. Madison C. Peters, Walter Satterlee, the artist, Dr. Harriet Barkeloo, Miss Mary A. Lathbury, "Jennie June," and Miss Frances E. Willard.

"GOOD MORNING!"

The question of cost is one that interests everybody. A comfortable summer cottage can be built and furnished for $1500, lot included, and a log cabin for less than $1000. Taking into consideration the cost of taxes, repairs, maintenance, and table board, the experience of cottagers has been that this style of living is not more expensive than that of ordinary boarding-houses, while far more economical than living in a hotel. In a cottage, however, there will be far more room (one house will contain 14 adults), and a home-like feeling is fostered that cannot be rated in dollars and cents, while for children there is no comparison between the two plans of summering.

Where tents have been utilized as a cheap substitute for houses or for the benefit of living entirely in the open air, the expense is insignificant. The present article has been written in a perfectly comfortable tent, costing, with stove and piazza, hammock and rustic seats, hanging baskets, running water, and other appurtenances, less than $200. Several similar structures have been erected in the different parks and are proving very popular.

At Camp Comfort, near Bennington, in the Green Mountains, a number of simple and cheap houses have been built, costing with

housekeeping facilities less than $300 each. There is a central dining-hall for those who prefer going out to meals, and the residents have enjoyed several seasons of outdoor life and freedom from conventionality at small outlay. The camp lies in a famous trout section and the company owning the property propose laying out an extensive game preserve ; none of the land is sold and houses are only leased, so that the enterprise is not strictly coöperative.

Experience has shown the need of strong and capable management, backed by ample financial resources to sustain and perfect a cottage colony. Nothing does itself, and improvements cost money and must be carefully planned at the outset. Unless due regard is paid to essentials, and especially to sanitary details, trouble is sure to follow. Social needs also require attention. Care must be taken in the choice of lot-owners, and there is always danger of discord and indifference, breeding trouble. The permanent outcome of these experiments will be watched, therefore, with interest.

The accompanying illustrations will serve to show the salient features of some of the cottages in the Catskills and elsewhere, more particularly in their interior arrangements. In some cases the actual cost is given to indicate how little outlay is necessary to furnish a summer-home. The sketch of an artist's log-cabin represents the summer-home of Dan. C. Beard, in Pike county, Pennsylvania, and is an example of what is called in the Adirondacks a "refrigerator" house, with an open-air parlor, having rooms on either side and overhead. It is cooler than a piazza and more cosy, but hardly so economical. This cabin was planned for housekeeping and can accommodate a family of a dozen.

It is hoped that these examples of how to live in comfort with the least waste of labor and money will lead others to establish similar enterprises in other sections, wherever land is cheap and accessible, so that thousands of weary men and women may regain health and taste the delights of free communion with nature. There is room for a hundred parks in the Catskills alone, and any company of congenial souls who care to experiment can do so at little cost, by hiring an old farm-house as a center, putting it in charge of some smart Yankee housekeeper, and erecting tents or cabins all around it for occupancy. With taste, gumption, and a little capital there is no limit to the possibilities of such enterprises, and they are almost certain of success under favoring conditions.

ELECTRICITY.

Conducted by Franklin L. Pope.

NOTWITHSTANDING the lack of commercial success which apparently has attended thus far every attempt to operate electric street-railway cars by means of storage-batteries, there has been little or no relaxation in the efforts of inventors to solve the problem. The widespread prejudice in the public mind against any and all systems of overhead electrical distribution, however unintelligent and unreasonable it may appear to those familiar with the subject in all its bearings, is nevertheless an existing fact, and must be met and dealt with as such. Nor can this feeling, at least under the conditions which exist in many places, justly be regarded as a wholly irrational one. In view of what has already been accomplished, it is idle to assert that it may not be possible to operate a street-railway system by storage-batteries, or by underground distribution, in such a manner as not only to furnish adequate accommodation to the travelling public, but to insure profits to the transportation companies, which, if not excessive, shall be at least sufficient. It must be remembered that the objection to the overhead conductors is not removed, merely by the demonstration of the fact that the question is not one of danger to human life, but is almost purely an esthetic one. Looking at the matter from no higher plane than the mere question of dollars and cents, the property-owner has an undoubted right to demand that the appearance of his premises shall not be unnecessarily marred in order to increase the convenience of one portion of his fellow-citizens, or the bank-balances of another portion. Private interests must necessarily and rightfully be subordinated to the rights of the community, but this general principle confers no warrant for the infliction of injuries which can by any possibility be avoided. Hence if it can be successfully established that either a storage-battery system or a system of underground distribution is commercially practicable, it will find an important field of operations impatiently awaiting its advent.

THE question is often raised whether the improvements which have been made —say during the last five years—in storage-batteries have been such as to justify the expectation that the obstacles which have hitherto prevented their successful application to street-cars, speaking in a commercial sense, are likely to be overcome. These obstacles, when carefully considered, are found to resolve themselves mainly into two, one of which is the great non-paying weight of the equipment of batteries which must be carried upon each car in order to furnish a sufficient amount of power, not only for its normal operation, but for meeting such emergencies as are certain to occur, and the other is the comparatively short duration of life of the batteries themselves, as measured by the rate of depreciation. It may safely be affirmed that material progress has been made in a direction which tends to diminish both these objections. The more recent and improved types of storage-batteries have been designed with special reference to the possibility of obtaining a high rate of discharge without at the same time disorganizing the material components of the cells. This result is advantageous in many ways. It increases the life of the cells, and thus directly reduces the cost of maintenance and renewal, while at the same time it largely diminishes the weight of battery necessary to be transported in order to provide for a given maximum tractive effort. A moment's consideration will show that if we have a given quantity of energy stored in a given weight of battery, we may cause a greater power to be given out for a short time or

a smaller power for a longer time, but the more rapidly we exhaust the contents of our battery the more frequently it will be necessary to refill or replace it. The replacing of exhausted cells by refilled ones is a mere matter of mechanical detail, and presents no insuperable difficulty, but the real source of trouble has always been that a rapid rate of discharge has been found ruinous to the permanency of the batteries, and hence it has been necessary to carry a large number of cells, in order to be able to discharge them slowly, and yet get a sufficiently powerful current. Thus the improvements above referred to, while perhaps not tending to materially diminish the absolute weight of a battery in proportion to its storage capacity, nevertheless make it possible to very greatly reduce the weight which must be carried by a car in order to provide the necessary power for contingencies.

A CORRESPONDENT of the New York *Evening Post* recently has given a very intelligent and interesting account of a storage-battery system which has been in operation since April, 1891, on the Milford and Hopedale railway, in Massachusetts. There are six miles of track and six cars, of the size and type of the ordinary two-horse street-car. There is a long grade of 4 or 5 per cent. and a short one of 10 per cent. When running down grade, the motor acts as a dynamo, thus performing the double office of checking the speed of the car and of returning to the batteries a portion of the energy which had been previously abstracted from them in ascending the incline; a conception due, we believe, to Mr. F. J. Sprague. The statement is made that on one round trip a series of precise measurements showed that 17 per cent. of the total energy drawn from the batteries was returned to them in this way. The charging plant consists of two 20-light dynamos and two 60-horse-power engines, one of which, presumably, is used as a reserve. The weight of battery carried by each car is given as 4200 pounds, and is placed, as usual, under the side seats. The statement is made that two 7½-horse-power motors are found to be ample for the cars used, while with the trolley system two 15-horse-power motors are used, in recent practice, for the same size of car. This comparison is, of course, wholly fallacious, inasmuch as the capacity of a motor to perform a given amount of mechanical work depends upon the quantity of electrical energy utilized by it, and cannot possibly be affected by a difference in the character of the source whence it has been derived. If equal work is to be done motors of equal capacity must be used. The plant described seems to have been designed and managed in an unusually intelligent manner, and the results attained cannot fail to be of value. Unlike any system of central-station distribution, the problems to be met and overcome in respect to the successful application of the storage-battery in a small plant like this do not differ intrinsically from those which would be presented in an installation of almost any conceivable dimensions. The difficulties which would be encountered in an enlargement of the field of operations would be administrative rather than technical.

ONE of the most important undertakings now actually in progress in the way of an electric railway is the Cayadutta line, which is being constructed for passenger, freight and general service between Fonda, Johnstown, and Gloversville, N. Y., and which will therefore come into direct competition with an existing steam railway connecting the same places. The new road will be seventeen miles in length. A single contract has been awarded to a New York firm for its entire construction and equipment, the estimated cost being about $300,000. The cost of the existing steam road and its equipment was about $500,000. A comparison of the financial results of the operations of these two competing lines will ultimately elicit no small amount of valuable information.

There is a narrow-gage steam railway between Worcester and Lake Quinsigamond, Mass., used principally for summer-excursion traffic, which has recently been paralleled by an electric street line. The steam road is 2.7 miles in length, and cost,

including equipment, about $100,000. In 1891 it carried 528,000 passengers, and earned $38,000 gross and $17,600 net. The parallel electric line is practically of the same length, and probably cost about half as much. With the same number of passengers, its gross receipts would be $26,400. The steam line is operated very economically, there being but nine persons in all employed, and it would seem to be a rather difficult matter for an electric system to show results much more satisfactory. It was at one time contemplated to apply electricity to this narrow-gage line, and considerable work was done several years ago in fitting it up for that purpose, but the plan has been, at least for the time, apparently abandoned.

SOME of the leading railways which are equipping their lines with electric block-signal systems, have wisely determined to place the connecting electric wires underground. The Central Railroad of New Jersey has recently laid its lines in this manner through the city of Elizabeth, and now it is announced that the New York Central Railway is to lay its signal wires underground between Albany and Buffalo, having given an order for 12,672,000 feet of high-grade insulated wire, being some 300 miles of 8-conductor cable. The manifest superiority of this method will doubtless make itself apparent when the results of its operation for a year or two come to be examined.

THE peculiar adaptation of electricity to mining work, by reason of its economy, flexibility and general convenience are now well recognized, but in its application to the operation of percussion drills many difficulties have been encountered. Most of these difficulties, however, have been so far surmounted that the electric drill has come to be regarded as a practical and useful instrument. It has been urged, with apparent reason, that the use of compressed air as a motor for drilling is almost a necessity in order to effect proper ventilation. Practical miners, however, say that instances in which the exhaust air from the drill is relied on for ventilation are very rare, so that this consideration has little real force.

THE new central station of the Edison Electric Illuminating Company of Boston, now approaching completion, described in a recent number of the *Electrical Engineer*, worthily represents the most advanced ideas in modern electrical engineering. The station has been located on deep water, not only with a view to economy of transportation of fuel, but to secure an ample supply of water for condensation at a nominal cost. The present station is only about one-fifth of the ultimate intended capacity, but is ample nevertheless to meet the demands of the present and the immediate future. The power equipment comprises fifteen 325 horse-power boilers, and nine vertical condensing triple-expansion engines, six of 1500 horse-power and three of 750 horse-power, running at 120 revolutions under 160 pounds pressure. The electric generators are of the modern direct-current multipolar type, and are coupled in pairs direct to the engines. Each generator has a capacity of 160 volts and 1333 amperes, giving an equivalent of about 5800 16-candle lamps for each engine when under full load. Each pair of generators is connected with the mains on the three-wire system. The gross weight of each generator is 43,300 pounds, of which the armature alone is 10,900 pounds. The switches and regulating apparatus are mounted on marble slabs, and embody many novel features. There are at present connected to the mains in the district served the equivalent of 65,000 16-candle incandescent lamps, 400 arc lamps, and 3000 horse-power of motors, in units varying from 60 horse-power to 1½ horse-power. There are about fifty miles of underground feeders and mains in connection, some of which are of enormous capacity. The details of this installation are most admirable, both in conception and execution, and embody all the latest improvements both in mechanical and electrical engineering.

THE laying of a heavy submarine cable used to be regarded as a very formidable

undertaking, requiring much time and very elaborate preparations to prevent possible mischances. Mr. W. H. Preece, of the British Post Office Telegraphs, in a paper read before a learned society in London some years ago told of having seen a cable picked up in the Hudson river near New York, 1¼ miles in length, in forty minutes, and relaid on another route in six minutes, and observed that in England it would have taken one week to pick up and repair the cable and another week to relay it, which was no doubt to some extent a humorous exaggeration. A few days ago, however, an 18-conductor telephone cable 5300 feet in length, was successfully laid across the same river from shore to shore in five minutes by the watch.

A WRITER in the *Electrical Engineer*, in a review of the progress of electric lighting in England, gives some figures which exemplify in a most forcible manner the results of over-much governmental and municipal interference in matters of this kind. Of the seventy-eight cities and towns which have obtained Parliamentary powers to construct and operate municipal electric plants, only two have thus far availed themselves of their franchises, while on the other hand out of the thirty-seven powers obtained by private corporations, twenty-two have resulted in the erection of central stations. The large provincial towns of the kingdom seem actually to have done nothing, the appreciation of the advantages of electricity apparently existing only in the smaller towns and villages.

DR. R. H. THURSTON, in commenting upon the work of the Electrical Engineering Department of Cornell University, says that it has been proposed to inaugurate in that institution a course of lectures and design work relating to telegraphic and telephonic construction and practice, but adds that such a scheme cannot be carried out successfully without some assistance from the great corporations controlling these operation in this country, "which," he says, "have not been as much interested in their opportunities to do good work in this direction as have the makers of light and power machinery. The latter have always been both liberal and helpful. The former take no interest in the subject and are inclined to make the whole a matter of commerce, simply." That there is too much truth in this indictment is a matter of common observation. The short-sighted and narrow spirit of commercialism which for many years has apparently dominated the management of some of these large companies, especially the telegraph companies, must ultimately recoil upon themselves with most injurious effect. While during the past decade giant strides have been made in every other department of applied electricity, the advances in the department of telegraphy have been comparatively unimportant. The younger, brighter and more enterprising employés of the telegraph companies, finding little encouragement for ambition, or scope for achievement, have been for the most part drawn away into other lines of more congenial electrical work, until the telegraphic service has become as it were permeated with a sort of dry-rot. This should not be. There is as much scope for improvement, and as much need of it, in telegraphy as in any other field of human endeavor, and the management will find it to its ultimate advantage to wake up, and follow the enlightened policy of the other electrical interests which has been so justly commended by Dr. Thurston.

THE telegraphic circuits extending from London direct to the various cities of the Continent, fifty-nine in number, have been supplied with current since October, 1891, from storage-batteries arranged in groups of fifty cells each. The cells are kept well charged and the E. M. F. is never permitted to fall below 1.95 volts per cell. The results are said to be extremely satisfactory. In this country, in the larger stations, the telegraphic circuits are supplied directly by dynamo-electric machines without the intervention of storage-batteries. It is a much mooted question which plan is better. Each undoubtedly possesses certain advantages lacking in the other, and there can be no question that either is preferable to the primary battery. There are

now few towns in this country in which a main-line telegraphic battery is situated, which have not also an electric-lighting plant of some kind, and in all such cases it would certainly seem as if a storage-battery might be employed, and that it would not only give better service, but be considerably more economical than the primary batteries hitherto exclusively used in such cases.

ELECTRICALLY-PROPELLED launches to the number of forty are to be provided for carrying passengers on the lagoons of Jackson Park during the World's Fair. A contract for their construction has already been made with a New York firm.

MR. W. E. J. DEMING states that he personally investigated every fire in Minneapolis during the year 1891 which by the remotest possibility could have been due to electric wires. There are in use in that city 60,000 incandescent and 2000 arc lights, not to mention motors and street-railway lines, but only eight fires proved to be due to electricity, and these involved a total loss of less than $100. If safe wiring in accordance with approved rules could be made compulsory, and could be enforced by competent and honest inspectors, the risk of fire from electric wires would be almost inappreciable. If the amount of dangerous wiring in existence were fully known, we think the wonder would be rather, not that there are so many fires, but that there are so few.

A BUILDING erected recently in Denver, Col., contains some twenty rooms above the ground floor, intended to be occupied for light manufacturing purposes, which are to be supplied with power by electric motors from a single dynamo-plant located in the basement. From a switchboard in the basement, a separate distributing circuit, provided with an ammeter, extends to the premises of each individual consumer, thus enabling the actual power used by him to be checked by the engineer. This is an enterprise which apparently might be copied with great advantage and profit in thousands of places throughout the country, where either steam or trustworthy water-power is available.

WITHIN the past few years an increasing interest has been manifested in the important question of highway improvement, and some creditable highway construction has been done, in New Jersey and elsewhere, with very beneficial results. But Mr. William Nelson Black, in an article in the *Electrical World*, points out that even if only comparatively few of the main roads of the United States are to be improved, the cost will mount up to a sum which will be wholly inadmissible, and he furthermore shows quite conclusively that a resort to the assistance of the State is not likely to help matters very much. Mr. Black considers, and in this we are in entire accord with him, that the most hopeful solution of the problem of difficulty and discouragement that surrounds the American farmer of to-day, is to be looked for in the general distribution of electric power over the whole country from central stations, and its utilization, not merely for transportation, but for all the work of the farm, now carried on so expensively, laboriously and inefficiently by the muscular power of men and animals. It needs but little study of the actual figures to appreciate how enormous would be the magnitude of the saving if this most flexible and tractable of all agents could be made to do even a comparatively small portion of the farm work of the United States. As Mr. Black pertinently remarks, it will be cheaper and more sensible to render the improved highways unnecessary, than it will be to get the highways. We believe this to be the most important problem pressing for a practical solution to-day. It is one which will bear any amount of discussion.

MESSRS. A. W. HEAVISIDE and R. C. Jackson, in a paper read before the British Institute of Electrical Engineers, have given an interesting description of an alternating-current central-station lighting plant in Newcastle-on-Tyne. The capacity of the generators is 137½ kilowatts. The

four main circuits are carried underground in concentric cables insulated with vulcanized rubber and drawn into cast-iron pipes, of which about ten miles have been laid. The main circuits are worked at a pressure of 2000 volts, and the transformers are placed upon the consumers' premises, as is usual in this country. The mean number of lamps in use during the year gave a capacity of 342,000 watts, equal approximately to 6850 lamps American measurement. The price charged consumers, which was characterized as "phenomenally low," was 4½ pence per Board-of-Trade unit, which may be reckoned as equivalent to 0.75 cents per 16-candle lamp per hour, or 25 per cent. less than the usual price in this country. This low price was, however, rather a necessity, as the lighting had to be done in competition with gas at 40 cents per thousand, the price charged in Newcastle. The cost of the entire plant figured out £50 per kilowatt, equal to $186.50 per horse-power. The loss of energy in distribution, as determined from a comparison of the station meters with the consumers' meters, amounted to 25.4 per cent. The average proportion of lamps alight at any one time to the total number of lights installed was about 45 per cent. The average number of lamp-hours per annum for different classes of consumers was as follows: Restaurants, 1563; stores, 459; offices, 499; private houses, 344. The average of lighting hours per annum was 714.

In a subsequent discussion of this paper, Mr. R. E. Crompton compared the results given with those of certain companies operating in London and using direct-current systems, in respect to the items of fuel, oil, stores, water, labor and superintendence, reaching the conclusion that these expenses were 40 per cent. more in the case of the alternating than in that of the direct system of supply. He stated that his own experience as an engineer had convinced him that even over an extended area the first cost of the alternating system showed little saving over that of the direct system. Per contra, Mr. W. H. Preece pointed out that a capital account of £50 per kilowatt amounted to no more than 30 shillings per 8-candle lamp, which was less than the amount expended on mains alone by some of the low-pressure stations in London. He said that the total capital expenditure of some of these companies ran as high as £5 to £6 per 8-candle lamp. A system established in a town like Newcastle, if installed at one-third the cost, could be operated at twice the expense and yet leave margin for a very handsome dividend. Mr. Heaviside said that all the paper pretended to be was a statement up to December 31, 1891, of what it had cost to put in an alternating plant and serve nine miles of route with electric energy, no promotion or other costs of like nature having been incurred; in fact it was a case of electricity upon its merits.

IT is announced that an improved type-printing telegraph apparatus has recently been perfected, in which the transmitting apparatus is externally similar to an ordinary typewriter, and is operated in the same way, while the receiver automatically records the communication in transverse printed lines upon an endless band of paper eight inches wide. The transmitting operator, by means of his keyboard, has full control of the distant receiving instrument, and can vary the length of a line or the space between two successive paragraphs or telegrams at will. It is said that a speed of 40 words per minute has been attained over a circuit of 300 miles, which is practically equal to that of any of the existing manual systems.

THE manifestations of cosmical electricity which have occurred during the present season have been in many respects not a little remarkable. Mr. John W. Rusk, an amateur scientist at Haines Corners, N. Y., a point in the Catskills some 2000 feet above tide-level, has been fortunate enough to secure some remarkable instantaneous photographs of atmospheric electrical phenomena, which we have examined with much interest. One of these shows a horizontally undulating discharge of great length, terminating apparently in a bright star-like point; another one shows a vertical flash which appears to the eye to

be bunched, at a point half way between the zenith and the horizon, into an intricate and singularly contorted knot. The only apparent explanation of this strange appearance is that it is a foreshortened view of the upper portion of the flash, which in reality pursued an irregular spiral course. Numerous thin, lateral branches, uniting with the main flashes, may be detected by careful observation, seeming to indicate that the principal discharge in each case may perhaps be due to an aggregation of lesser ones. Another class of electrical disturbances, bearing an intimate relation both to sunspots and to auroral displays, have also been remarkably frequent this season. The effect of these on telegraph lines and on submarine cables has been so remarkable as to attract universal attention. On July 16, and again on August 12, the manifestations were so violent that the entire telegraphic service of the United States was practically paralyzed for several hours. The direction of the current on a New York-Providence circuit was reversed over 150 times within 15 minutes, and a difference of potential of no less than 492 volts was at one time found to exist between the earth in New York and the earth in Boston. Some of the phenomena observed are difficult to be accounted for on any rational theory of cosmic action.

THE average cost of exhausting incandescent lamp-bulbs by means of the Geissler pump, in a manufactory having an output of about 2000 lamps per day, is given as a trifle above 1½ cents per lamp. The preliminary exhaustion, to within about half an inch of barometeric pressure, is effected by a specially designed mechanical pump.

MR. F. P. MILLS has sent us an instantaneous photograph of one of the most remarkable exhibitions of lightning we have ever seen, which was secured on Lake Superior, near Marquette, Mich. The principal flash, which extends from the zenith to the water's edge, is vertical and nearly straight, and as it is apparently beyond the horizon line, and several miles distant, it must have been of enormous length and volume. The forked appearance is very conspicuous, all the branches being directed downward, and one of them passing below the horizon line. One is lost in amazement in trying to imagine the difference of potential capable of producing such a prodigious discharge of electricity.

IT is announced that arrangements have been made by which the entire output of the Anaconda copper mines is to be refined by the electrolytic process at the works of the Baltimore Electric Co., instead of sending it to Europe as heretofore. The works in Baltimore are now in process of enlargement to a capacity which will permit 4,000,000 pounds of copper ore per month to be treated.

IN a paper read before the Institute of Electrical Engineers, Mr. Nelson W. Perry enters a plea in behalf of the series system of current distribution for electric-railway work. The limitations of constant potential distribution are well understood among electrical engineers. At a maximum pressure of 500 volts, the limit of distance in economical distribution is soon reached, yet there are many reasons which preclude the employment of a higher pressure. Theoretically, long-distance work can be most effectively carried out by conductors of uniform size traversed by a constant current, but the unavoidable complications of apparatus, and the difficulties of detail which arise at every step, would seem to render the problem of devising an efficient series system for railway work almost a hopeless one. While the suggestions of Mr. Perry are ingenious and in many respects novel, we nevertheless fear that when submitted to the trying ordeal of a practical demonstration they will fail to meet the requirements of the case.

MECHANICS

Conducted by Frederic R. Hutton.

IT is an interesting fact, to be explained perhaps on economic grounds, that in London the distribution of hydraulic power from a central station to elevators, cranes, etc., has been developed as it has not been in this country. A paper on this subject was recently read in London by Mr. E. V. Ellington, giving some facts from the practice of the Hydraulic Power Company of that city. The principle of action in hydraulic systems of this order is that of the practical incompressibility of water. If water be pumped into a vessel fitted with a piston or plunger and loaded with a given weight, it is obvious that the plunger will not rise till the pressure per square inch upon the water is in excess of that exerted upon that water by the weight of the plunger. If a system of closed pipes be taken from the chamber carrying this weighted plunger, it is obvious that the pressure in these pipes will be the same as that in the chamber, and that, if by opening a valve from such a pipe that water can pass against the movable ram of a crane or elevator, a force is exerted per square inch of ram area the same as that in the accumulating reservoir. If the volume of the accumulator pistons be made large, it is obvious that very considerable drafts of water can be made upon the system without the fall of pressure amounting to anything, and it is exceedingly simple so to arrange the throttle valves of the pumping plant that the pumps shall work slowly when the accumulators are full or nearly full with the plungers protruding from them, but shall work more rapidly when the accumulators are empty because of drafts from the service main. The pressure used in London is 700 pounds to the square inch; at this pressure two and-a-half gallons furnish the equivalent of one horse-power in foot pounds. They endeavor to keep the diameter of the pipes large enough so that the velocity of flow in them shall not exceed five feet to the second, in which case the loss of pressure is usually so small as to be negligible. For elevators and cranes the experience of the company has been that they are able to obtain at the working point an efficiency of 55 per cent. of the power put in at the steam end of the pumps.

FIBER-GRAPHITE is the name given to a new material presented to the use of engineers as a material for lining boxes and bearings. It is the invention of Mr. P. H. Holmes, of Gardiner, Maine, and consists of a mixture of wood-pulp and finely divided graphite thoroughly incorporated together with linseed-oil as a vehicle. The mixture, having been molded into the required shape, is pressed with great pressure and dried, in which shape it is ready for use. The lubricating properties of graphite have long been known, but this device making it an integral part of the bearing surface, has given a satisfaction which leaves for many purposes but little to be desired. The bearings run without oil, by which of course are avoided not only the expense of the lubricating material, but the dirt and injury which oil may cause, and the danger from fire. Exceedingly satisfactory results have been obtained both in the field of ordinary machine bearings and in the departments of electricity and engine-building. Its application differs from that accorded to metaline, which was used in pencils inserted into a special bushing. The action of the new material under long-continued service, and the shocks from alteration of strains such as occur in connecting rods, will be watched with interest. A paper on the subject presented at the recent meeting of the American Society of Mechanical Engineers called out a discussion of considerable interest. With

the roller and ball bearing the new material will tend materially to diminish the hurtful losses from friction in machine design.

ATTENTION is being directed anew in several of our large cities to the use of compressed air for street-car propulsion. In some cases the nuisance of the stables and the value of the ground which they occupy are prominent factors, outside of the expense of the horses themselves. In others the prejudice against the electric railway with accessible wires prevents the introduction of that convenient form of road, and makes the compressed-air solution almost a necessity. It is by no means settled, however, by which of the various forms it is practicable to have the compressed air applied. The electric street-railway has at least had this effect upon the compressed-air system,—that it compels it in this country to a greater speed than is exacted from the successful roads of the compressed-air type in Europe; and moreover in many districts of this country the compressed-air system meets obstacles unknown amid the milder climates of Europe.

Leaving aside for the moment many details of the application of compressed air, there are two fundamental distinctions of method. The first one is perhaps the most natural and involves the use of motor cars containing tanks of large volume to be charged at the power-house with air at a high pressure, sufficient in quantity to run the motor for its trip. This system is analogous to the storage-battery method in electric systems, and is open to the same difficulties. The first is the great weight of the storage appliances, and the second is the inconvenience from its exhaustion while in transit, making it necessary that the car be towed into the power-house when its own supply has failed to the manifest disturbance of regular trips and the annoyance of its patrons. It is also necessary that the air be compressed at the power-house to a high pressure in order that a sufficient weight of it may be stored in any reasonable volume for use on a trip of any ordinary length. Inasmuch as the compression must necessarily be accompanied by the development of heat in the compressed air in amount proportional to the degree of compression, it would appear that with high pressures to be carried any distance, and be held for any time, there must be from the cooling a material loss of efficiency as compared with a method not calling for such a considerable compression. It is judicious of course in motors of this type to use the multiple-expansion principle, so that high-pressure air coming on a cylinder of small diameter shall permit the escape of the air from the exhaust of the final cylinder of relatively larger diameter at a pressure nearly that of the atmosphere. The alternative plan in this system is to introduce a reducing valve between the high-pressure reservoir and the engine, so that the latter shall receive the air at the usual and normal pressures. The reducing valve introduces some heat into the air by reason of the friction through the constricted passage, but this heat can readily be obtained more satisfactorily in other ways, and the reducing system is not generally preferred.

The second general method of applying compressed air involves the carrying of a main under ground along the line of the route, from which the reservoirs under the seats of the cars can obtain supplies of air at intervals. Two competing systems involving this principle differ in the amount of pressure carried in the mains and to be used at the car, and in the mechanical details employed to get the air from the main into the reservoirs. The presumption would seem to be in favor of the plan using the low pressure, if the mechanical details were equal in the two plans. The idea of both is that at intersections of streets where the car would naturally stop to take on or let off passengers a connection shall be made by a suitable conduit between the car and the main through a man-hole plate in the street. A very few seconds of rest recharge the reservoir, and the car, severing its connection with the main and closing the outlet by the severance, starts off with fresh vigor. At most and worst the car has only to run between the man-holes, and the driver should never let his pressure fall to a point where there should

be any danger of this. When this system was first proposed some years ago, in the experimental example it was possible to recharge the car without its coming to an absolute rest, but of course in daily service with connections deteriorated from use such precision could not be depended upon. It is not desirable in most cases. The compressed-air motor, with its absence of smoke, cinders, heat, danger, and notable noise, will be a successful competitor with any other form of motor, if its commercial success can be established and its satisfactory working depended upon. There is avoided the loss of power which attaches to the cable system, and in quiet streets the noise of the continuous running cable and its sheaves.

WHILE the conception of artificially cooling the air to be introduced in the hot season into hospitals and theaters has been before the minds of engineers and sanitarians for some years, it does not seem to have suggested itself that the same principles should be applied to large office buildings where as many people are assembled for business purposes, and where the wear and tear of mind and body would be much diminished if the air in the rooms were kept below 70° instead of above 80° in the tropical season. A recent paper by Mr. A. R. Wolff, member of the American Society of Mechanical Engineers, has considered this subject with some interesting results. Allowing 2000 cubic feet of air per hour per person, there must be put into motion 147.2 pounds of air, and to lower this weight of air ten degrees requires the absorption of 350 heat units per hour. While to do this work for a thousand persons by ice, at $5.00 per ton, would cost $5.00 per hour,—a figure practically prohibitory,—it can be done on an ammonia ice-machine upon the principles of mechanical refrigeration with coal, at $3.00 per ton, for fifteen cents per hour for each thousand persons. This would have to be increased by the general items, such as supplies, attendance, interest, etc., but a higher rental could be charged in artificially-cooled offices, which would more than offset the increased outlay, particularly if rent day, with its adjustment of price for the following year should fall in such intemperate cycles as engineers and other office-workers experienced during the last days of July, 1892.

THE Pennsylvania Railway Company is making use of an ingenious form of pipe-joint. A special fitting is cast, having a flanged joint, whose plane cuts the axis of the fitting and pipe at forty-five degrees. It is obvious that when the two halves are so put together that the long elements of the cylinder of one section are continuous with the short elements of the other section, we have a plain, straight joint in a continuous pipe, while with the flange turned 180 degrees from this position, so that the short elements match short elements on the two sections, we have a ninety-degree elbow, and midway, or at ninety degrees from the first position, there is a forty-five degree elbow formed. The joint in the flange is made with a ring so as to be tight. It is necessary, in such a flange, that the number of bolt-holes be multiples of four.

A NEW and very compact form of damper-regulating device has recently been presented by Mr. John Levy, of Canada. As applied to a balance disk damper in a pipe or flue, the spindle of the latter carries a pinion; this pinion gears into a rack which is moved in one direction by the action of steam pressure from the boiler tending to close the damper and in the other by a spring compressed by an adjusting nut so as to hold the steam in equilibrium at the desired pressure. Should the steam pressure rise, the piston moves upwards, pressing the spring and closing the damper; under a fall of pressure the spring forces the piston back and opens the damper correspondingly. The piston is expected to be at the bottom of its cylinder when the damper is wide open.

AN interesting application of the principle of automatic regulation of draft was recently applied in this city by Mr. A. A. Cary, member of the American Society of Mechanical Engineers. The draft of the

steam-boiler was furnished by a fan-blower, and, between the driving-shafting turning at constant speed and the counter-shaft of the blower, was introduced a varying-speed mechanism so that the blower would have its number of revolutions increased or diminished according to the adjustment of the speed device. This adjustment was made automatically by the steam pressure, so that as the steam pressure rose the blower would be slowed down, but as the steam pressure fell the blower would be speeded up. The most convenient speed device for a case such as this is probably a pair of cones if the driving belt is crossed, which must become conoids if the belt is open. The belt, guided by a fork, will run the driven shaft faster than the driver when the belt is nearer the large end of the driving cone, but slower than the driver when the belt is near the small base. The conoidal shape is required for the open belt (unless the belt is quite long), if the belt is to have equal tension at all points, due to the varying length of the part of surface of the cone which the belt touches at different points of its length.

AN increasing amount of literature is accumulating on the subject of rope-driving as a means of transmitting power to machinery. It is interesting to observe that the cable-railroad in San Francisco seems to favor rope-driving from the main engine to the jack shaft almost without exception, while in the Mississippi valley it seems to compete with gearing for this purpose. There are two systems of rope-driving, known as the English and the American; the English system involves the use of a number of separate ropes, running side by side, each having its own splice. The American system, on the other hand, is to use one continuous rope making several turns around each pulley, the successive turns filling successive grooves, and the slack taken up by a bight of the rope passing over an idle pulley, strained either positively or by a weight. There is, of course, but one splice in the American system. It is doubtless the case that each system will have its own advantages under special conditions. In the English system of multiple ropes they will hang slack as they stretch until they commence to slip by too little tension. This very slackness brings a less severe side strain on the bearings, and in the multiple system single ropes can be replaced successfully as they may show signs of slackening or giving out. There will generally be a sufficient excess of rope so that a drive can be run with one of its components slack or broken until it may be convenient to shut down. In the American system, on the other hand, while they are not annoyed by the slipping, the failure of the splice shuts down the entire drive until it can be made good.

Rope-driving competes with gearing and with flat belting. For the transmission of large powers in shops and subsidiary transmissions the flat belt has so many advantages that the rope scarcely may be there considered. It has naturally had an extensive field in England, where the historical system of distribution of power, illustrated by Fairbairn and the early millwrights, carried the power from the steam-engine in the basement upwards to the successive floors by a vertical shaft from which to horizontal lines the motion was taken off by sets of double-bevel gears. The superior lightness of the rope-drive, doing away as it did with the noise, friction, and weight of the vertical shaft and its gears, was obviously an immense improvement, and their millwrights were not slow to perceive it. There was obtained absence of vibration in the building which made possible a lighter building and fixtures, and had the result of reducing the first cost of the plant. Rope-driving, moreover, has very great advantages over flat transmission in the ease with which corners can be turned, and in the satisfactory working, particularly under the American system, where the driving and driven shafts are directly over each other. The weight of the broad, flat belt sometimes introduces a tension sufficient to diminish very seriously the pressure for contact on the lowest pulley. In any case ropes can be run slacker than a flat belt to do the same work, inasmuch as the rope running in a

groove in the face of a pulley has greater hold than the flat belt upon the flat surface. In English practice the coefficient between the rope and the pulley is said to to be three times that of the flat belt. With rope-drives, moreover, it is by no means necessary that the driving and driven shafts be essentially parallel to each other. In cases where the different parts of the building settle unevenly, the rope-drive offers notable advantages. At very high speeds ropes are not troubled with the difficulty from entrained air which seems to follow the working side of the belt and the pulley, and while, of course, the centrifugal force developed in ropes of high speed cannot be neglected, yet it appears in the actual working, due perhaps to the wedging action in the grooves, that it does not act as prejudicially as in the flat belt all in one piece.

It is the practice in this country thoroughly to lubricate the ropes used in driving with graphite and tallow, working the lubricant between the strands, so as to reach every fiber if possible. The English practice as recorded by Mr. William M. Bell in a recent paper implies the use of the rope without such preparation, beyond an occasional dressing with castor oil to prevent brittleness in the fiber. The best service for indoor drives seems to be gotten from cotton, flax, hemp, or manilla. The angle to be used for the grooves in the pulleys in rope transmission seems to be still a subject of discussion. The first pioneer in this field in England, Mr. James Combe, of Belfast, used forty-five degrees in 1860, which seems to be still the favorite design, but thirty degrees is also in use, and sixty degrees as well as fifty-three, which latter has been proposed for a compromise between forty-five and sixty. But some successful practice in New England uses a forty-five degree groove, the contact being a curve tangent to the forty-five degree slope, struck with a radius of seven inches for a 1¼ rope.

Rope-drives are figured as costing from one-half to two-thirds that of flat leather. The pulley diameter has an important effect upon the life of a rope drive, a ratio of thirty to forty diameters being a satisfactory one, and permitting a life of many years, in some cases as high as from ten to fifteen before it has to be replaced.

A FORM of sheave for rope-driving has recently been brought out, which contains some novel features. Instead of being all in one piece, with the necessary number of grooves, the sheave is made in sections, a single set of arms carrying a single groove, and between the single sheaves thus formed grooved rings can be bolted so that any desired width can be gotten, and the number of the ropes in the drive easily and constantly increased. Such a sectional pulley, moreover, can be more satisfactorily balanced in use than when the sheave is all in one piece.

WHILE the ordinary form of water-wheel governor is sufficiently sensitive for many purposes, yet in the use of water-power to drive dynamos, with the necessity for an automatic regulation of the power, since the load may vary with the phenomenal rapidity sometimes experienced in this practice, the attention of engineers has been directed to improving this form of apparatus. The old form in very general use involves a ratchet wheel with dogs. The arm carrying the dogs was reciprocated regularly, and the revolving balls of the governor rendered inoperative either the dog by which the gate was lifted, or the dog by which it was lowered, as the variation in speed might occasion. Where there is no reason for economizing water, the plan carried out by Mr. F. E. Pritchard at Oswego, in which he made use of a rheostat of iron wire, nearly equal to the gross capacity of the generator, is of course a practical solution. At normal demand for current this was out of use, but by an automatic device, if at any time the speed was increased from five to seven per cent., there was as much current shifted into the rheostat and absorbed by it as when the outside resistance was normal.

CHICAGO contemplates the erection of a chimney which is to be of steel and 350 feet high. The lower 75 feet is lined with fire-brick eight inches in thick-

ness, supported at intervals of 25 feet by an angle iron riveted to the steel shell, so that the lining and shell shall expand independently of each other; above the 75-foot line hollow tile is used for the rest of the way. The plate is ⅜ of an inch thick at the bottom, and is gradually reduced to $\frac{5}{16}$ of an inch at the top. The outside diameter is 9 feet 5 inches, while, if made of brick, the usual proportions would require that it should be 16 feet 6 inches in diameter. It rests upon the usual foundations required for high buildings in that district, which consists of a grillage of steel rails laid in cement, resting upon a cement layer upon the ground; on top of the rails is a layer of beams on which rests the cast-iron shoe that takes the shell of the stack.

THERE has recently been brought out in Boston a new tool for boring holes of more than one geometrical form. It has long been known that a square hole could be bored, but the principle by which this is effected is now extended to the production of triangular, hexagonal, or octagonal shapes. The drill-shank carries a cam attached to a cam arm, and on its end is a slide bed and a slide carrier with cam-pin and roller. The necessary adjusting nuts adapt the arrangement for different sizes and for the variations in the shape of the holes.

A RECENT interesting extension of the field of the submarine diver has been made in Italy. The ordinary submarine vessel has been intended and designed almost exclusively for use in war and as a weapon of offense; it has been left for the Italians to organize a company for the recovery of submarine goods, and to design a submarine vessel with this object in view. It is a steel vessel, very much the shape of Columbus's egg amidships, 28 feet long, 6½ feet broad at its widest point, and 9¾ feet deep. The screw is driven by an electric motor, and it is intended to carry five men for forty-eight hours under water. An air-lock arrangement near the stern permits the crew, if properly equipped with divers' dress, to leave the vessel without admitting water into it.

AN ingenious application of mechanical principles has recently been made in England for the washing of sand used in the filter-beds of waterworks plants, where the water contains much solid matter in suspension, and filtration on a large scale is necessary. The most satisfactory method of such filtration is to cause the muddy water to percolate through beds of gravel and sand, in the interstices of which the earthy matters shall be left behind. The consequence is that after not many hours of use the filter clogs by the filling of all these interstices, and the cleansing of the sand becomes necessary. The method used for cleansing at Kew Bridge, and described in London *Engineering*, involves the use of a series of cast-iron hoppers placed about seven feet apart. Each hopper is provided near the bottom with a ⅜-inch jet pipe connected to a main in which a pressure is maintained equivalent to a head of 75 to 100 feet. This jet discharges into the open end of a two-inch delivery pipe, which passes upward obliquely to discharge into the next hopper of the series, and by an injector action discharges the sand and water into the next hopper. The dirty sand from the filters is scraped into heaps in the usual way, and wheeled into a receptacle from which it is raised by a similar injector into the first of the hoppers. The last hopper discharges the clean sand into a truck on the filter-bed, leaving the lighter dirt behind it in the successive hoppers of the series. Five thousand gallons of water are used per cubic yard.

IT is interesting to observe the attention which is being given in England, as well as in this country, to the development of small motors to furnish the power which is required in detached houses or in suburban districts to meet the needs which in our complex civilization are supplied in the cities from large plants. The fundamental condition of such problems is that no skilled labor of an engine runner shall be required, and that there shall be no danger from the storage of large quantities of power in boilers or other reservoirs, from which their sudden release might work

harm. The cleanliness, the coolness, and the absence of products of combustion from the incandescent electric light, have given it a warm place in the favor of those who occupy country mansions as a competitor with oil or gas. And if the oil or gas can be utilized in a suitable engine which shall drive the necessary dynamo for supplying current in a satisfactory manner, it would seem that the development of the oil and gas engine was a promising field.

The difficulty which has to be surmounted in the case of the glow-lamp is the irregularity of the rotational speed of thees gas engines, even with their heavy fly-wheel, when they are not fully loaded. Under these circumstances gas is not taken into the working cylinder at every stroke, and there will be an acceleration above the mean, and a drop below the mean, due to the varying effort at the successive strokes, which tells disagreeably upon the light. This difficulty can be mitigated by interposing a storage battery as a condenser between the motor and the line, but unfortunately this additional complication is just unsatisfactory enough to make the venture at the present time somewhat of an experiment. It has been mitigated upon some special designs of dynamo by putting steel disk fly-wheels upon the revolving armature, so that the living force which is stored directly in the armature may keep up its speed even if the motor should vary.

Where gas is available, recent experiments would indicate that a brake horse-power can be had at an expenditure of from nineteen to twenty-four cubic feet per hour, and as one brake horse-power is usually figured to be capable of running ten sixteen candle-power glow-lamps it would appear that at the ordinary price of gas, the equivalent illumination can be secured by a gas engine and dynamo combination at considerably less cost than the gas burned directly with the attending advantages. Moreover, where the motor is in use, it can be applied for other purposes, such as running an elevator, or pumping, or for any of the services which will at once occur to any one who has the power at his command. These facts give especial interest to the extensive exhibitors of these types of motors in recent expositions.

Of course where gas is supplied there are considerable advantages in its use as compared with oil. The oil engine must make the oil into gas, and the question is whether it can be done most economically by the motor itself, as needed, or on a larger scale at the gas works. Of course the presumption would be in favor of the economy of doing it on a large scale, but when account is taken of the fact that the consumers pay the company for part of the enormous leakage which they concede, and for the dividends which they hope for, it may be questioned whether the manufacture of the gas as required in the oil engine may not really be the cheaper, in spite of its apparent drawbacks.

A classification of the different types of motors seeking the English market shows that the differences between them can be grouped under three heads. First, those having an attachment by which the oil is made into a spray with air, which spray can be readily converted into a vapor in shape for ignition upon its entrance into the working chamber.

The second class contains those differing from each other in the detail of having the gaseous vapor received and converted in an extension of the working cylinder, and open to it, or in a jacket extension of the working cylinder having a closed connection between the two, opened only by the admission valve.

The third class contains those which convert the oil in a separate vaporizer heated by an oil lamp using a forced combustion. All the classes can be separated with respect to the method by which the charge in the cylinder is ignited, using either an electric spark, an ignition tube heated by an oil lamp, or by the heat received from the hot walls of the combustion chamber aided by that due to the compression of the gas by the working or a detached cylinder.

ARCHITECTURE.

Conducted by Barr Ferree.

A PAPER on "Architectural Problems in Great Cities," read before the American Economic Association at its meeting at Chautauqua in August, dealt with some novel aspects of architecture. Architecture in great cities, and especially in American cities, is no longer the ornamental and ornamented art it was in "the good old times." The middle ages were distinctively an art era: the nineteenth century is as distinctively a business and manufacturing epoch. The conditions which prevailed in the one do not prevail in the other. We have not passed beyond appreciation of beautiful churches and splendid public buildings, albeit we have few examples of either on which to feast our eyes and imaginations in this country, but we have long since passed the point at which these fascinating structures make up the sum total of architectural work. As the mediæval cathedral is the most conspicuous object in the old continental cities, so the modern office-building is the type of architecture in the new cities of the new world. We may deplore the lack of picturesque variety in the sky-lines of our cities; we may regret the departure of the art days of the past; but if we would console ourselves for these changed conditions, and find satisfaction in the work of the present day, we must admit, once and for all, that we build under conditions of our own, which have no precedent in former times. We must measure our work by our own standards and requirements, not by those of a dead past. No one thinks of passing on the beauty—or ugliness—of modern fashions simply because they are not modelled on those of the thirteenth century; why then should we make the architectural productions of that time, great and beautiful and wonderful as they are, the criterion of modern architecture? Yet consciously or unconsciously this is what the larger part of writers and critics of architecture do. Pick up any guide-book, run through any encyclopædia, and the buildings described as characteristic of any city will be the great churches, the city-hall, if there be one, the public buildings, and perhaps the most noteworthy — which being interpreted means the most ornamental—of mercantile and financial structures. Possibly the residence of some noted citizen, or the scene of some celebrated event may be noticed; the great mass of city buildings are unmentioned, because, it may be supposed, they are too insignificant. It is characteristic of the times to omit the many for the few, to single out individuals at the expense of the bulk of society.

Any study of city architecture which ignores the conditions under which modern cities thrive and grow, no matter how minutely special structures may be described, falls ludicrously short of completeness. "Hamlet" with Hamlet left out would be a very singular play indeed. New York minus its tenements would not know itself. Tenements and stores and private dwellings and apartment-houses and office-buildings and railroad-stations and factories and warehouses—the thousand and one forms of structure pressed into service by the requirements of city life or the necessity of business—may not always be models of architectural elegance, but they make the bulk of the city, give it form and definiteness, express its relative prosperity and greatness. The "400" may give elegance to society, just as the churches and public buildings do to municipal architecture, but it is the masses which make the city what it is, and even give distinctiveness to the chosen. Tenements and factories may be utterly uninteresting as specimens of architecture, but they are part of the essential structures of great cities like London and New York. The greatest achievements of modern ar-

chitects have not been in the production of monumental edifices, but in improving ordinary dwellings, until the old-fashioned house, temporarily diverted to office use by the changes of fashion and the fluctuation of population, has evolved into the great modern office-building of to-day, with its thousands of tenants, its multiplicity of devices for shortening work, improving health, bettering humanity, and—it must be said—increasing the rent and adding to the wealth of the landlord. The thought of the time runs to business and money-getting: what more natural than that our architecture should bear the impress of these national sentiments, and be looked upon chiefly as a source of revenue and as fulfilling business conditions? This may not be the best model for human thought to mold itself on, it may not be the best form for architecture to seek to give expression to, but we think so and build so, and, until our thoughts change, we will keep on building so. The sooner the inevitable is admitted the better. All modern office-buildings do not fulfil modern requirements either in points of convenience or in utility; they are frequently wanting in architectural expression, and too often indicate their money-making qualities. But we have many structures of which, notwithstanding their faults, we may well be pround. And they are more than sources of pride—they mark a positive contribution to the betterment of human life.

These, however, are but a few of the problems suggested by the study of architecture in great cities. The massing of a great population within narrow limits, the very situation and plan of the city itself, provides a problem not only of transportation but of architecture. The question of rents and revenue is another powerful factor in the development of modern architecture, the last element perhaps exerting more direct influence than any other single one. Men nowadays do not build for art's sake, but for the money they can make. Buildings are investments, and stand on the same foundation as stocks and bonds and other revenue-securing commodities. The art element passes into comparative insignificance in connection with these. When we are prone to lament the lost architecture of the past, and bewail the fact that we cannot produce structures such as our remote ancestors did off-hand, as it were, it would be well to remember the actual status of the art among us. Take the question of population. Two-thirds of the people of New York city live in crowded tenements, that is, in dwellings or places of residence containing twenty-one persons or over. Many of them contain not less than fifty persons. These figures disclose a social question of great difficulty, a moral question of great seriousness, and an architectural question of vast magnitude. Talk as we will of bettering the laboring-classes by means of Sunday-schools and missions and contact with Christian men and women, the whole matter must remain unsolved so long as the people live in vile houses where privacy is a mockery and every architectural and sanitary device for improving life is ignored. How is it possible to improve the masses when fifty people are crowded into the space that was only built for a single family? How can regeneration be accomplished when not only will an entire family live wholly in one room, but as many as four families occupy each a corner of a single apartment? These questions are food not only for the moralist but the architect. The architect personally cannot remedy them; he cannot do other than carry out the instructions of his client, but he can at least discuss the subject from the architectural standpoint and thus bring to this terrible question the light of practical experience. In New York city these questions are more burning than in any other because it is the tenement-house city of America, if not of the world. Every year more and more people are crowding into its tenements with no prospect of a decrease. A ride on the Second-avenue elevated road is an instructive object lesson in the social life of tenements, and is one of the most serious problems of architecture in great cities.

WHEN will the public, and especially the Eastern public, learn to appreciate the real merits of the new business architec-

ture of Chicago? It is bad enough for foreign travellers to take a hasty glance at our great inland metropolis, ridicule its greatness, and print their effusions as sound and unbiassed criticisms, but it is positively distressing when American writers, setting out to chronicle the wonders of the city, find nothing of interest or value in its architecture. One of the latest and most conspicuous instances of the way in which some people delight in writing about things they know absolutely nothing about, is furnished in a recent issue of the *New England Magazine* in an article entitled "The Heart of Chicago." "But few even of the latest office-buildings," remarks this sapient critic, "have any architectural features of excellence, the effort being to get the greatest possible amount of room in a given area, so that many of the lofty buildings are as picturesque as a dry-goods box pierced with holes for windows." The fine wit in this remark only helps to bring out the utter stupidity of its author. A business building is intended for business, and the more room that can be had in it the better the owner will be pleased and the more perfectly the building will answer its requirements. Suppose, for argument's sake, that the finished structure does resemble a dry-goods box. Shall it be condemned because it has no pinnacles or gables or recessed windows, or elaborate carvings, with which Eastern business buildings are sometimes embellished? Is a building to be thought the better because it is something different from what it should be? The *New England* critic, who, by the way, is a resident of Chicago, does not tell us how these business structures should be designed, but clearly the Chicago methods do not meet with his approval. It is difficult to know, in this case, which is the more to be pitied—the writer who can give utterance to such stuff or the editor who would select one so blind to modern progress to describe the central portion of Chicago, in which are more and better business structures than are to be found in any equal area on the face of the earth. The reasons for this condition of affairs have already been referred to in these pages—the strict adherence of the Chicago architects to the programme presented to them—and they need not be repeated at length, but it is impossible to read the amazing statements of the *New England Magazine* article without regretting that a fairer treatment of so important a part of Chicago's characteristics should not have been given in so respectable a publication.

Perhaps a better time is coming, and the critics of the East really give to the western architects the true appreciation which is their due. The strange rivalry engendered by the newspapers of New York and Chicago towards each other is resulting in a most amusing series of critiques, in which the papers of one city publish singular sketches anent the other. The New York *Sun* began the battle some time ago with a most preposterous dissertation on Chicago, and since then those whose weary burden it is to read the Sunday press have been regaled with estimates and criticisms which should cause their objects to bow their heads with very shame for not coming up to the eastern or western standard, as the case may be. A youthful observer in the *World* gives utterance to these words of wisdom: "The architect has not yet appeared able to make the new building look like a serious and genuine structure, or to devise something characteristic and beautiful with the new and wonderful facilities at his disposal. Chicago is waiting anxiously for that person." This is news indeed. But then the able critic of the *New England Magazine* tells us the same thing. "The world is waiting," he remarks, "for the architect who will design a building of this class which will happily illustrate its method of construction." Unfortunately, neither of these investigators give us any idea of the form in which this expected architect will clothe his ideas. Fascinated by the idea of steel construction, both these gentlemen seem to think that the skeleton construction should be manifest on the exterior. As it is safe to say they both of them keep their own bones covered with as much flesh as they can accumulate, it is most unreasonable to insist that because a skeleton system of building

has been devised the structure should exhibit it to the world. A building, as well as a man, would look very odd with its skeleton outside its covering. Chicago may be well satisfied with what its architects have accomplished without waiting for a revolutionist that will set the world by its ears. They have struck the right path, and as long as they continue to progress on the lines they have laid down for themselves there is nothing but hope before them. Some of the Chicago ideas are needed in the East; the New Yorker who employs a Chicago architect to erect in New York a Chicago building in the typical Chicago style of architecture will be a public benefactor.

OF all cities in America, Philadelphia is the one whose architectural eccentricities provoke the most mirth; it is, therefore, a matter of no surprise that in instituting a competition for a Bourse for that city—which is to accomplish all sorts of wonders in making it a town of the first rank—one of the most remarkable architectural messes of the century should have been manufactured. The gentlemen having the new enterprise in hand prepared a programme for a general competition for the new building, one of the features of which was that the actual work should be carried out under the direction of an engineer, chosen by them as superintendent of the building. Never in the history of architecture had so gross an affront been offered to an unoffending body of architects. It is not surprising that the architects of the city rose *en masse* and refused to participate in such a competition. If we cannot build the building we design, they declared, we will not design it. And they were quite right. Atrocious as much of Philadelphia architecture is, there is no reason at all to suppose the architects of that city incapable of superintending their own work. This reflection was bad enough, but when there was added a further humiliation in the way of reduced fees the matter became too utterly distressing. Fortunately, there has been nothing at all in the whole history of the case that reflects on the architectural brethren, save perhaps their offer to compromise—a most dignified and worthy utterance—a matter that calls for no compromise at all. The indications it gives of the status of practical architectural affairs among the better class of people in Philadelphia are much more unfortunate. The new Bourse is intended to indicate the resources of a new Philadelphia, wealthy, cultured and wide-awake. Yet the very men who are laboring for this outward grandeur burden their enterprise with an attempt to secure a building at special and reduced rates, a petty piece of economy which should have no part in a work of this kind, and at the same time propose an arrangement which no self-respecting architect could accept. Philadelphians have been in the habit of thinking architectural critics unjust to the works of art which adorn their streets, but the most unkind things said by a foreign observer is nothing compared to the affront offered to her own architects by her own people in this preposterous muddle. The matter is still under active discussion by all parties, and it will doubtless result in freely ventilating the merits and demerits of architectural competitions and thus be not without value, even those the points at issue are not satisfactorily discussed.

"THE Laws Relating to Buildings in the City of New York," edited by Mr. William J. Fryer, make a valuable and useful book which should be in the hands of every one interested in architecture in the metropolis. The new law contains many changes in the previous law, which it is impossible to condense in the space of a single paragraph. The experience gained under the operation of the earlier law, and its amendments in 1885, 1887 and 1889, have been fully availed of in the new code, and as it now stands it confers great credit upon the gentlemen who were active in drafting it, as well as upon the legislature which passed it. Perhaps the most important innovation is the consolidation of the Bureaus of Plumbing and Ventilation of the Health Department, and the Bureau of Buildings of the Fire Department into the new Department of Build-

ings. Nothing has been more singular nor more annoying to architects and builders than this useless subdivision of one department as minor portions of two quite distinct departments. Even now the consolidation of all branches is not complete, a Bureau of Fire-Alarm, Telegraph and Electrical Appliances having been erected in the Fire Department, with which architects will have to deal. New fire-lines have been established, a most important regulation in a crowded city like New York. Beginning on the west side at One Hundred and Sixty-fifth street the line extends easterly from the North river to Eleventh avenue, thence north to One Hundred and Eighty-first street and east to the Harlem river. On the east side it commences at One Hundred and Forty-ninth street, from the Harlem to Trinity avenue, and thence to the East river. In addition to the Building Law Mr. Fryer's book includes the regulations of the Building Department, Tenement- and Lodging-house laws, the law limiting the heights of dwelling-houses, the laws relating to the extinction and prevention of fires, and explosive and combustible materials in buildings, the regulations of the Department of Public Works, the State Factory laws, and the Mechanic's Lien law. It is illustrated with a number of valuable diagrams, prepared by the editor, and is a most serviceable work, with its bold headings, marginal notes, and ample indexes.

BOSTON has been provided with a new building law by the legislature which has recently adjourned. It contains many changes on the preceding law, and in some respects is more stringent than the New York law. A Department for the Inspection of Buildings has been formed, the chief of which is to be an Inspector of Buildings to be appointed by the Mayor. He must be an architect, a builder or an engineer. The most interesting features of the law are those concerned with diminishing fire risks, which form one of the most important municipal problems. It requires that any tenement, lodging-house or dwelling of five stories or more in height shall have a fireproof basement and first story, and be constructed in a fireproof manner as far as the third floor. Such construction is of inflammable material throughout, with floors of iron or steel beams filled in between with terra-cotta or masonry arches. Wood may be used for under and upper floors, sashes, doors, and in places where generally employed. No air-space is permitted between the top of any floor arches and the floor boarding, or behind any woodwork. All buildings seventy feet in height, or which may be increased to that height, must be constructed throughout in this style. Each district inspector is required to attend the fires in his district and be prepared to advise the fire-engineers of the nature and construction of the building. No structure, except spires of churches, shall exceed 125 feet in height. Neither shall any building, save church spires, exceed in height more than two-and-a-half times the width of the widest street upon which it is placed. The streets of the business portion of Boston are among the narrowest and crookedest in the country, and this limitation of height may not be without its advantages in certain regions, but it is a severe restriction on building in its busiest districts. The question, of course, is a broad one, though not devoid of local significance; the constitutionality of such measures has been questioned, though not carried to the test. There is, however, a popular distrust of the high building, whether from speculative or possible danger is immaterial, that is gradually being manifested in all our building laws.

THE long series of strikes which have demoralized the building trades in New York have ended in the complete defeat of the men, or rather of the Board of Walking Delegates, for whose benefit these disastrous conflicts were undertaken. It has been one of the fiercest battles in labor annals, and the defeat is the more crush- for that reason. The first of August saw strikes of one kind or another in active operation on upwards of a hundred buildings in New York city. It was quite in keeping with the thrifty habit frequently mani-

fested by the workingmen that no sooner was a reasonable amount of activity manifested in building than strikes begun. Workingmen do not strike, as a rule, when times are dull: then there is little use of it; it is only when there is plenty to do that strikes are inaugurated and the lamentations of the down-trodden laboring-man fill the air. Doubtless he has his grievances, as have all of us, but he is not satisfied with suffering alone. The proverb that misery loves company, finds no more complete illustration than in the history of strikes. Not only must his fellows share his misfortunes, as they share the impositions to which he is exposed, but thousands of others who have no connection either with him or with his especial grievances, are called out on that fine invention of modern industrial life—the "sympathetic" strike. As for the employers, the tremendous cannonading which the owners of the Homestead works are now receiving on all hands is a fair example of what they may expect. So far as the building strikes are concerned there would seem no greater folly than precipitating a conflict with capital the moment work can be had after a slack winter. The men lost public sympathy by voluntarily subjecting themselves to continued idleness at the very moment when work is most abundant and the prospects of a good season of the best. The final results of the conflict are not yet visible, but it will unquestionably materially affect the methods of builders. The employers cannot undertake contract work with heavy penalties when their building is liable to be stopped because A and B will not grant certain demands of their men. It must also affect building as a whole, and it is not unlikely that there will be a not inconsiderable diminution of building in New York in the next year or so from this cause. A man about to build is like a man who sends a job to a printer; he wants it finished at once. He does not begin this year in order to complete his work season after next. The tendency of all recent building has been towards increasing speed of work. Continual strikes that constantly retard operations must have a serious effect.

THE New York *Herald* is nothing if not original; its proposal to erect a new building for itself far up-town is not the least of its attempts to avoid ordinary plans. That the building will be devoted exclusively to the *Herald* is an advertisement of no insignificance, and conveys an impressive lesson of the growth of the newspaper press. But the *Herald's* new site is an ample one, while its new building will be but two stories in height, and the single distinction gained, therefore, is that it will not be an office-building in which the owner will have his rent free and a profit on his investment beside. The tendency in modern business methods is quite the contrary to that adopted by Mr. Bennett. Each great firm or corporation that now builds a home for itself seeks to make it a source of profit. It has not been with the idea of being above ordinary mortals that the newspapers of New York have built huge office-buildings of which they occupy but a small portion. On the contrary this self-paying system, if such it may be called, is a direct economic advance, putting the ground to its fullest use, and materially reducing the expenses of the owner, even though the profit be small. So thoroughly have these views been adopted by the building public, and so characteristic have they become of modern building, that a return to the old system is nothing short of a retrogression. This may seem a harsh word to apply to a paper so eminently progressive and wide awake as the New York *Herald*, but it simply expresses the truth. The subject is one without public interest, and concerns only the gentleman who pays for the new structure, but as the novelty of the plans has attracted considerable attention, it is well to note, that while the building will doubtless fully answer all the requirements demanded of it, its owner will not receive the largest return from his land. Perhaps he does not need this; and certainly there is no active demand for offices as far uptown as Thirty-third street; it is not impossible, therefore, when all New York moves up-town, that the present two-story structure will be turned into an office building of the most approved type.

CIVIL ENGINEERING.

Conducted by T. Graham Gribble.

IT is amusing to see the daily press blossoming into large captions over the great Canadian project of draining the lakes by a Huron-Ontario ship-tunnel. Whatever grounds there may be in the statements of the Canadian press for this crazy notion, the scheme is unworthy of mention except as it has been built upon really feasible projects which have been talked of for years and which were described in the writer's recent articles in THE ENGINEERING MAGAZINE, entitled "The Future 'World's Highway.'" Either a ship-canal or a ship-railway from Georgian Bay to Toronto is quite practicable. It would not interfere at all with the level of the lakes, and it would make a direct line for shipping from Lake Superior to the Saint Lawrence. The other idea of a canal from Lake Nipissing to the Ottawa river is not so feasible, and does not possess the element of romance which has been given to the Huron-Ontario tunnel affair, because under no circumstances could it be made to drain the lakes. It is difficult to credit the Canadian newspapers with any engineering support for this wild idea. If this is a sample of tunnel-stories which can be gotten up by our neighbors, they would do well to start a new "Baron Munchausen," for it would find an excellent sale on both sides of the Atlantic. The sequel to this one should be that Canada, having drained away the American waters, will buy up Uncle Sam and his damaged country at its value before he came there. Let us hope that with these noble projects in full array Canada will begin by improving the Welland Canal and the Saint Lawrence Canals, especially the latter, unless the 25 to 50 millions involved in these little details are too insignificant for her to think about just now. Speaking seriously, however, it is not wholesome for the present fiscal rearrangements to echo with the word retaliation. Every department of business is learning to treat cut-throat policy as folly, and for great nations even to amuse themselves with ideas of this kind is something very like second childhood.

TO ONE who, like the writer, has allowed about three months to elapse since his last visit to the World's Fair grounds, the present aspect is startling and conveys some idea of the business-like determination of Chicago to get its great show into shape by Dedication day. Then the park was barely emerging from its native swamp. The skeletons of the great frame buildings were appearing, but the grandest structure of all—the Manufactures Building—was represented only by a platform. It was the first day of the edict prohibiting visitors unless furnished with a passport. After a strenuous effort the needed document was obtained, but no challenge was received until, after a complete survey, the writer was returning by the way he came. Then a seedy-looking policeman made a rough remonstrance at the departing visitor. On being questioned whether his duty was to keep visitors from getting home again he subsided into mutterings. Now a corps of uniformed custodians watch every building. The public is admitted, under some unpleasant restrictions, on payment of 25 cents. After making a complete tour of the buildings under a grilling sun, and arriving at the southeastern end of the Manufactures Building, the writer was quietly informed by the ornamental hireling that he could not go out across the park, but must circumperambulate the grounds by the way he came. The sole reason alleged was that some visitors had been hurt by falling scaffolding. After ineffectual remonstrances the weary visitor was beginning to retrace his steps. Suddenly a happy thought struck him, which is given here for the benefit of others.

When opposite the center of the Manufactures Building, he displayed a common rule stowed away in his note-book, and walked with quick step and critical eye upon all the materials right through the building, past all the sentries, and so out of the grounds, without being once challenged.

The usual entrance is by Sixty-third street, at the Transportation Building,—a noble pile which is still very much in the hands of the carpenters,—thence northwards to the Horticultural Building where the great roof is glazed, the pipes are laid on, and the interior is rapidly being made ready for the plants. Passing on to the Woman's Building, we find what by itself would anywhere attract attention as a fine structure, but among so many grander ones does not impress the visitor as much as its merit demands. The exterior is complete with the exception of the roof. The sparsely-distributed "caryatides" supporting the upper parapet look as if they needed a few "persians" to relieve their loneliness. Male criticism of the interior is precluded by the placard "For ladies only." To the north the Illinois State Building is seen in an advanced stage, and passing into the Fisheries Building we come at once upon what bids fair to be the most artistic and the most attractive feature of the Exposition. The work of the celebrated Henry Ives Cobb, it will add greatly to his reputation. The general effect of the exterior is not pretentious, and the contiguous United States Building with its magnificent dome catches the spectator's glance away from it. The Fisheries Building is a gem which needs looking into. The annexes are surrounded by lovely columns with every capital a different group of fishes. Round the cornice is the "frog's dance," with an occasional gargoyle of unspeakable oddity. All round the columns is a spiral device of elegant tracery. At the top of the central dome, which is still full of scaffolding, will be a great tank for supplying water at about 100 pounds pressure. The tank construction is well forward, and it is hoped to have a live whale as the occupant of one of them. Going eastwards to the Naval Exhibit, we find the "stationaire" with her bottom plates on, but otherwise still a study in well-pointed brickwork, the turret being just now plastered with a broom. The permanent bridge is not yet in place, a wooden "jack-knife" structure temporarily forming the crossing of the entrance channel. On putting the question to the ornamented hireling in charge at this point as to whether a fixed bridge or a swing bridge would be placed there, we were informed in a rich brogue: "Of coorse, 'twill be fixed, but it will turrn round at its middle." As we pass on southwards, the great structure of the Exposition—the Manufactures and Liberal Arts Building—occupies our attention for over a quarter of a mile. The huge steel roof principals, pivoted at the crown and springings, are all in place, the framework is complete, and the external drapery of "compo" work is beginning to appear on the towers. The rebuff of the sentry previously referred to prevented us here from observing much of the Mines and Electrical Buildings. The Administration Building, which to the administration is a name to conjure with, is completed with the exception of little more than the gilding of its dome. The colonnade of pillars guarding the entrance to the lagoon has been commenced. Here it is expected by the Chief of Construction that the visitor from other shores will pause and dream of Venice. He now has to pause and go back again at the stern command of the hireling. Well, in spite of restrictions the visitor now has a good 25 cents worth, and the administration expects to realize $500,000 from gate-receipts before the actual opening.

The Illinois Central Railway is busy elevating its tracks outside the gates to abolish the present grade-crossing, which would have made a slaughter-house of their station on the arrival of the crowds. The Elevated Railway has the foundations of its columns in place along the greater part of Sixty-third Street, and its superstructure is built up to Fifty-third Street. This railway promises to be one of the best means of transportation to the Exposition, and to have a fine future before it. There seems no reason for expecting any failure

to come to time with all the work in hand. We have no space to tell of the beautiful drives and walks which are being laid out, the esplanade on the lake, or the serpentine lagoon. The whole scene is a spectacle of human ingenuity and diligence such as probably never yet has been.

MR. ERNEST KOHL, in *der Civilingenieur*, has made some analysis of the railways of the world, from the statistics of the German Government, extending up to the year 1889, and finds that the total mileage increased in the interval from 1887 to 1889 by 5.26 per cent. annually. The percentage was greatest in Asia and Australia and smallest in Europe. In Europe there were 3.7 miles of railway to every 100 square miles of territory; in the United States 5.3; in Great Britain 26.4, and in Belgium 27.35. In Europe there were 3.75 miles of railway to every 10,000 inhabitants, and in the United States 24.75 miles. The total length of railways in the world up to 1889 is estimated at 375,000 miles, or about fifteen times the equatorial circumference of the earth. The average cost of European railways is estimated at $280,000 per mile, and the total cost of all the railways in the entire world at $32,115,000,000. The cost of European railways is very striking as compared with that of American railways. In 1884, according to "Poor's Manual," the average cost for the whole United States for road and equipment was $55,330 per mile, or less than one-fifth that of the European railways. The minimum average was that of the Southern States, which was $42,338 per mile. The maximum was that of the Middle States, $92,306 per mile, or about one-third of the European average.

THE Patent-Offices, both of this country and England, remarkable as they are for the volume of business which passes through them, are still capable of improvement, especially on the other side of the water. In England a patent generally gets through more quickly than it does here, but if the patentee knows anything of the modus operandi he feels much less assurance under the great seal in spite of the big fees attaching to it than he does here. In America, where, exclusive of reissues, 22,327 patents were issued last year, every application receives careful consideration. A patent of a class in which the volume is small generally takes about four months before being considered. If of a class of large volume, such as corsets, baby-carriages or electrical appliances, it takes about a year. If we go back twenty years we can frequently find patents which were passed through in one week. For some reasons, considering the abortive character of by far the greater number of the patents issued, there may be some reason for giving the perfervid inventive genius plenty of time to cool off. It is, however, so well known that patents are valuable only as far as they are backed and defensible by capital, that the patentee begins to make his financial arrangements immediately upon the filing of his application and the prima facie merits of an invention generally guide the financiers' decision as much or more than the breadth of the claims. If they see their way to obtain by means of an ostensibly prescriptive right, the first start at a new business, they will generally go ahead, and it would be greatly to their advantage to obtain the allowance of the patent more promptly than they now get it.

In the case of a patent which takes four months to go through the office, a good expert generally can make his search in one day. If the examiner's clerk is equally rapid, it would simply imply that there was back work of about 100 patents to every clerk, and this back work is continually increasing. Either the work accumulates more rapidly than the examiner's clerks can be broken in, or else it is deemed expedient to let the work accumulate. There are many patentees who would be willing to pay double or even five times the ordinary fee for prompt attention. There would be nothing unreasonable in appointing a staff of "urgency examiners" who would take up such cases alone.

In England one of the peculiarities of the Patent-Office is in the preparation of abridgments of patents for the convenience of searchers. About seven years ago

it was decided to appoint a number of clerks for this purpose, who passed a competitive examination principally mathematical, and then started at a salary of $1250 per annum. It was soon found that these "literati" were not posted in technicalities and their salaries were raised to about $2000 and the work put out. The actual abridgers were then friends or acquaintances of the salaried officials. In one case a man's work was sent in in thirteen different handwritings, and as some not unnatural comment was made thereon, the gentleman afterwards resorted to a typewriter. Both in England and America the employment of ladies is much on the increase. It is all very well to give our "female brethren" a fair chance in such matters as glove-fasteners, coffee-pots or pencil-cases, but until they include in their education an apprenticeship in the machine-shop, it is not advisable to put them on to intricate details of machinery.

A RAPID-FIRING gun recently tested at New Haven by the Winchester Repeating Arms Co., fired 900 shots a minute. It is the invention of Messrs. Browning Brothers, of Ogden, Utah. The only gun approaching this rapidity is the Maxim machine-gun, with a record of 750 shots per minute. This new besom of destruction has a water-jacket surrounding the barrel, holding one gallon of water. The amount of water is evaporated in one minute, when the gun is in operation. In experiments made without the water-jacket, the barrel would become too hot for safety in less than half a minute. The ammunition is fed into the breech from a continuous web belt, holding the cartridge in pockets. The representatives of the Krupp, Armstrong and Canet guns have been engaged in a wordy tussle upon the respective killing capacities of these weapons. The initial velocity of the largest of these projectiles is now well beyond half a mile per second, and the penetrating energy varies from 200 to 300 foot-tons per pound of powder, with a momentum of about 80,000 foot-tons. That is to say, a mass of steel can now be hurled forth with a destructive power something like that of the average railway collision, but with what ultimate benefit to the human race is not so easy to determine. Canet claims to produce the same amount of damage as Krupp or Armstrong at half the money and with greater simplicity and elegance. This French gun has been adopted by the Japanese Government for three coastguard vessels. That brave though diminutive people find it the only weapon which one of their naval officers can handle alone. There is no wedge for closing the breech as in the Krupp gun which requires considerable biceps. The opening lever is so facilitated by screw multiplication that under normal powder pressures one man can easily work it in ten seconds.

Anarchists will be interested to note that the Gatling gun is now adapted to police patrol-wagons. Its weight is only 74 pounds, so that it can be carried if necessary by one man. When set up in a wagon it is designed to do more work in dispersing rioters than a column of infantry. The new Adamson gun substitutes a ball and socket joint for the ordinary trunnions. It carries five miles at an elevation of 25 degrees.

Torpedo boats are now built to travel 1800 marine miles at ten knots per hour on a total consumption of ten tons of coal, also to attain a mean speed during a two hours run of 24 knots, the engines running at about 300 revolutions per minute.

AT a recent meeting of the Engineers' Club of St. Louis a paper by Professor Malverd A. Howe, on the "Maximum Stresses in Draw Bridges," was read. The paper discussed the various loadings possible for drawbridges, under different conditions; then took up the case of a drawbridge of two equal spans acting as a continuous girder. For unequal concentrations the best method advocated was to compute the moments and shears for each panel for each load and then distribute the concentrations as nearly as possible according to the magnitude of these moments and shears. For actual wheel loads an assumed equivalent uniform load or a uniform load and an engine excess would give stresses nearly correct.

THE acquisition of street-railway systems by municipalities has been regarded by the public in this country with the same disfavor as the State ownership of trunk railways. The objection is founded upon distrust of the civic power, which appears to outweigh the many advantages attaching to the strong financial position and greater facilities for borrowing money at cheap rates possessed by municipalities. The State railway systems of Europe and India are hampered by many restrictions which would be unsuitable to this country, and the street-railway system, multiform in construction and operation, requires an elasticity of development in America which can only be attained by private enterprise. There appears to be a movement, however, in Europe, for municipalities to acquire existing street-railway systems from which good results may be expected. In 1894, at the expiry of the present franchise, the city corporation of Glasgow will own the street railways. Already the city of Huddersfield, England, has had some experience of municipal control of tramways and one of the improvements is most commendable. Instead of the former twelve-hour shift, the men are worked eight hours a day and the result has been profitable to the corporation as well as acceptable to the men. The main point in favor of this movement is the regard for the safety and convenience of the public, which may be expected to a greater extent from a city government than from a private company.

THE ship-railway project for connecting Georgian Bay with Lake Ontario is designed by Mr. Corthell. It will be similar to that proposed by Mr. Eads, for Tehuantepec, and adopted by the Chignecto Ship Railway Co. It will save about 300 miles of navigation through the St. Clair and Detroit rivers and the Welland canal. It will be about sixty-six miles in length, and consist of three standard-gage railway tracks with rails weighing 110 pounds per yard. Instead of curves there will be two or three hydraulic floating turn-tables. The maximum grade will be 0.62 per cent. Vessels of 1000 tons register, or about 2000 tons displacement and fourteen feet draught, can be transported. The cost is estimated at $15,500,000. Whereas the present agitation created by the shipping interest, both at Washington and Ottawa, is for a deep-draught waterway of twenty-one feet from the lakes to the Atlantic, and vessels of 4000 tons displacement are likely to become the standard carrier, it is apparently a weak point that this ship-railway should be designed for 2000 ton vessels with fourteen feet draught.

THE rejection of all the bids for the new Croton dam for the water-supply of New York was accompanied by a very explicit statement on the part of the Construction Committee of their reasons for rejection of the lowest bid. Mr. Fteley s estimate was $4,574,820. The lowest bid was $3,527,640, and the highest $5,549,998. This represents a wide range of prices, considering the character of the work, and the estimate being almost exactly midway between the extremes reflects credit upon the calculations of the engineer. That the Construction Committee were entirely free to reject the lowest bid cannot for a moment be questioned, nor that it was proper for them to give the tendering parties their reasons for so doing. It seems strange, nevertheless, that it should be necessary to publish the reflections which, in their rejection of the lowest bid, they deemed necessary to make of the status of that company.

THE Connelly Gas-Motor, which for several years has been in use at Port Elizabeth, N. J., but which has not hitherto succeeded in attaining general adoption, is likely to make a good start in Chicago. It has been experimented on for two years in that city, and it is said that Mr. Yerkes and his associates of the North Chicago Railway Co. have obtained a controlling interest in the patent, and will adopt it for branch-line feeders to the main cable system. The great advantage of an independent motor is that accidents do not block the whole line. The attempts to modify and conceal the steam locomotive for street-car service have not been very successful. The compressed-air motor and

the storage-battery motor are alike waiting for further improvements to make them generally serviceable. The statement that twenty Connelly motors are being constructed for the North Chicago railway makes us hope that a satisfactory independent motor has here been obtained. The writer had a special inspection made of this motor some three years ago at Port Elizabeth with a view to introducing it upon the street railways of Honolulu, and the report was a favorable one. The power is obtained from the combustion of crude naphtha, and the smell, though perceptible in the "dummy," was barely so in the tow-car. The cost of the crude naphtha imported to the Sandwich Islands was the chief reason for this motor not being adopted. There was also some apprehension of accident from experience with naphtha launches, but both of these drawbacks would not apply to a general use in the United States where the fuel is cheap and the skilled labor for handling it is easily procurable. There are several very ingenious devices in the details of combustion and mechanism. One of the latter is the variable speed gearing between the motor and the driving axle, by which the excessive starting power of the car is accumulated by a motor of the power needed for the running of the car and a 10-horse-power motor is sufficient for one tow-car or a 20-horse-power for two cars. The twenty cars being built by the Connelly Motor Co. of Illinois are partly 10-horse-power and partly 20-horse-power.

IT is with peculiar interest that railroadmen will watch the results obtained from the great electric locomotives which are being constructed by the Thomson-Houston Co., for operating the Baltimore belt-line tunnel. According to the *Electrical World*, they will be of 1200 horse-power, having four separate motors of 300 horse-power each—one for each axle. The potential will be 500 volts. No doubt the Rapid-Transit Commission of New York city will follow this development very closely for it will be, if successful, the solution of the problem for operating their trains in the underground railway. The electric motors of the London Subway though hauling 3-car trains are very much lighter than this and do not furnish sufficient data for establishing the economic feasibility of handling such a business as is being performed by the steam locomotives of the elevated railway. The load at the central station of the Baltimore line will be so great that no common form of installation would be safe. Special governors will have to be devised which will stand the sudden application and removal of 2400 horse-power at the central station.

AMONG the largest cables yet made for street railways are some by the Washburn & Moen Manufacturing Co. One for the Denver Tramway Co. is six miles long and weighs 43 tons; one for the Portland Cable Railway Co. is 6¼ miles long and weighs 38 tons, and another manufactured for the Metropolitan Street Railway Co. is 6.1 miles long and weighs 47½ tons.

THE ship canal promoted by Professor Haupt and others between the Delaware river and Chesapeake bay is receiving considerable attention. In consideration of its evident value as a direct freight communication between Philadelphia and Baltimore and its estimated cost of only $2,000,000, including extensive fluvial improvements, it appears to be a project full of promise. It will save vessels of deep draught the detour of 200 miles round the Maryland peninsula, and afford besides great advantages to the navigation of the Susquehanna and Delaware rivers.

THE recent experiments in Harvey nickel-steel armor-plate have shown an advance in quality on European plate. A 10½-inch plate received without injury the impact of five sharp-pointed chrome steel shot, each weighing 250 pounds and moving at the rate of twenty miles a minute.

THE mileage increase of United States railways in 1891 is placed by Poor at 3899, as against 5349 in the year before. The total up to December 31, is given at 170,601 miles.

MINING AND METALLURGY.

Conducted by Albert Williams, Jr.

LABOR-TROUBLES in the mining and metallurgical fields of this country seem destined to increase. It is idle to pretend that there is no real "war" between labor and capital here, for, while the economists and theorists are undoubtedly right in saying that there should be no true ground of difference between the two parties and that their interests are coincident and would be promoted by harmony, of what avail are philosophical aphorisms so long as people refuse to act up to them? We are still very far from the industrial millennium pictured by visionary enthusiasts, in which capital and labor are to work together for their mutual good. Things have to be considered as they are, not as they might or ought to be. Present conditions of keen competition, with the means of production ever tending to outrun consumption, press heavily upon all; and if capital has to figure very closely to make both ends meet, labor on its side has to suffer too. For every dollar of gross earnings there is bound to be a struggle over the division, and there is no disguising the fact.

The worst phase of the matter is the growing tendency of organized labor to resort to wrong methods of fighting its battles. Much is said about the oppression of monopolies, "trusts," and "combines"; little about the tyranny of labor unions, in which is more serious danger. No one questions the right of workmen to dispose of their labor as they see fit, or to withhold it; and if their interest is subserved by acting as organized units, to go on strike if they believe that will further their aims, though it seldom does. So, too, have employers an equal right to conduct or discontinue operations according to circumstances. It is absurd to expect them to run their works at a loss on eleemosynary principles. It is purely a matter of self-interest on both sides, and the most to be hoped for is that this self-interest may be an intelligent one, and that the adjustment may be as nearly as possible equitable; but the attempt to reach this compromise is seldom satisfactory all around in its results. There is also a third party, whose rights are hardly considered at all, and that is the class of non-union men. They have their rights, too; the right to sell their labor at their own price,—the right to work unmolested.

Organized labor puts itself in the wrong and forfeits public approval and sympathy when it goes beyond its rights and relies upon violence. The right to strike does not carry with it the right to intimidate, maltreat, or kill others who are willing to work, not the right to destroy property. The strikers, or locked-out men—the terms are immaterial—at Homestead respected property and threatened life; those in the Cœur d'Alene mines of Idaho went further and attacked both. The strike in the silver-lead mines of the Cœur d'Alene region, by the way, was an exceptional case, being an effort to compel the adoption of the same rate of wages for unskilled laborers as for skilled miners, and had no ground in justice or common sense. That at Homestead was against a partial reduction in the wage scale, affecting employés who were better paid than men doing equivalent work in other steel mills.

As a general thing, the feeling between employers and employed in the Far West has been fairly harmonious, and there is a closer inter-dependence. The troubles in the Washington coal mines and at the Omaha smelting-works last year, and in the Cœur d'Alene country more recently, were sporadic incidents. One reason is that the miners and other workmen are, on the average, of higher intelligence than elsewhere; another is that the unions are so strong that they can afford to move con-

servatively. Lately a proposed reduction of wages in the silver mines of southern Colorado was successfully resisted by the men, without the slightest threat of violence; and in Nevada the miners' union has always practically made its own terms. But the average tone of labor in that part of the country is being slowly lowered, with the constant advent of an inferior class; and the time may come when the state of affairs now existing in Pennsylvania will prevail generally. It is not a cheerful outlook, and it is difficult to see whence the remedy is to come. The coöperative plan usually breaks down in practice. Where, then, is amelioration to be sought? Certainly not in demagogic abuse in Congress and in the daily press, nor the employment of the militia and the hated Pinkertons, neither of whom are ordered to do more than protect life and property. Truly this is a time to say, pity the poor capitalist! He has only one vote and buys only one copy of a newspaper.

FAIRNESS calls for a modification—not a retraction—of the statement made in these columns in a recent issue that there was no hearty demand among mining men for the creation of a National Department of Mines. The discussion has naturally elicited some expressions favorable to the plan of forming such a Department, and a western journal has succeeded in obtaining opinions to that effect from several prominent engineers. A resolution was also passed at the Second Mining Congress held at Helena, Montana, in July, urging Congress to take steps in this direction by adopting the Campinetti bill. Those who favor the idea seem to miss the main points at issue, which are two,—the political bearing, and the question of efficiency. They argue that if it is well to have a National Department of Agriculture, then why not also one of Mines; that if the industry covered by the former is worthy of representation in the Cabinet, with a full-grown Department at its back, why should the great mining interest be left unrepresented? Why not also, one might ask, extending the argument to its logical conclusion, should there not be a Department of Manufactures, another of Commerce (now represented only by the Bureau of Statistics of the Treasury Department), one of Fine Arts, one of Literature, and so on? Why not enlarge the Inter-State Commerce Commission to a Department of Transportation (including Bureaus of Railways, Canals, and Roads), and raise the present Fish Commission and the Bureau of Education, etc., to the dignity of Departments, and carry the principle of paternalism to the extent of having the Government exercise a fostering care over each of the great industries, arts, and enterprises? The leather industry, glass-making, textile manufactures, and many other interests are highly important to the country at large and furnish the means of subsistence to thousands of our citizens, in the aggregate to be numbered by millions; why should all these people—with their equally numerous *votes*—be left out in the cold and continue to pursue their vocations unaided by official supervision and advice? That sort of argument reduces itself rapidly to absurdity. There is no telling where to stop.

A weightier consideration is that of probable efficiency. The Patent-Office examiners rule out certain claims as being for inoperative devices. It may seem presumptuous to assume in advance that a Department of Mines would be inefficient; and that it would not be, wholly. But we can't try a Department of Mines for awhile, and if it should turn out badly suppress it, for bureaucracy never goes backward. Granted that a Department of Mines might be beneficial to a certain degree, it hardly seems wise to further enlarge the existing functions of government, adding to the already too large class of office-holders, increasing national extravagance and the temptation to misuse federal patronage. But further, waving the political question altogether and all prejudice about the "spirit of our institutions," and admitting (as every one does) that the mining industry deserves all encouragement, and also conceding the great desirability of good mine inspection, reliable statistics, collections, investigations and an authorita-

tive source of information, all know that in parallel cases where the Government intervenes it does so at disproportionate expense, with discouraging friction from its machinery (the red tape used as material for the driving-belts having plenty of adhesion but more clogging action), tardily, and after all not very efficiently,—to put it mildly. There is only the light of experience for a guide.

All mining-men would like to see a live Department of Mines in operation; but those who have looked into the matter doubt the practicability of one. Hence, while they may not refuse to vote for a resolution or sign a petition or answer a journalistic inquiry aiming to further its creation, they do not as a class accord a very positive support. The trouble with our democratic form of government is that there is something wrong with the tone of our civil service, politics aside; sincere individual effort (where it exists in it) to do good work is handicapped, since for every foot-pound of useful energy applied several are wasted in overcoming inertia. This is the state of things at the best. What it becomes when political influences are superadded is worse. There is little faith in the efficiency of a Department of Mines for this country. It may be a good idea elsewhere, but it would not work well here. Those miners who approve of the proposition, without considering the inevitable drawbacks, would be sure to condemn the measure, should it be carried into effect, after a practical test had shown them its inadequacy.

MINE-SURVEYING formed the subject of a paper presented at a recent meeting of the Engineering Association of the South, by Mr. B. W. Robinson. The paper called attention to the rapid advances in mining during the past few years and in the general adoption of more scientific methods; and that the work of mine-surveying proper had not received the attention its importance warranted, either in standards of precision or in reliability of results.

Tunnel-surveying has reached a high state of perfection simply because of the high standards demanded. The author considered, as essential to good work, the following outfit: The complete mining transit arranged for vertical sighting and provided with extension tripod, vertical circle with bubble on telescope and stadia wires for outside topography, also a sensitive needle for checking vernier angles. Steel-tapes should be used for linear measurement and plummet lamps for sighting. Mr. Robinson considers that the compass and the link-chain should be discarded for mine work. As to the compass, it may be said that its use depends considerably upon the scale of the workings surveyed. For small mines and in projecting short connections a compass survey is often sufficiently accurate, if made with an instrument having a fairly long needle and good sights, and with proper checks by means of back-sights and precautions against local variations due to the influence of tools, rails, and magnetic minerals; while for large workings, and those which in time are intended to become large, a transit survey is of course to be preferred. The author also outlined a desirable system for an underground survey, with the manner of connecting it with the surface system. Important points in the underground system should be duplicated on the surface and monumented.

AT the beginning of the current year it was confidently anticipated that the output of silver in the United States for 1892 would exceed that of the previous year. Several new districts had just been opened, and the smelting-works were making or planning additions to their capacity, to meet the expected increase in the ore supply. An increased production of silver would mean also a corresponding gain in the gold, lead, and copper mined in connection with it. But the lower prices of silver and lead, coupled with the temporary closing of important silver-lead mines in Idaho, have counteracted the gain from the new sources; and the projected additions to the smelting-plants have not yet been fully carried out. Some of the weaker producers have closed down and others have reduced shipments. On the other hand, a few of the best paying mines have

adopted the policy of keeping up their cash receipts by marketing large quantities of silver and silver-lead ores. It is rather early to venture positive predictions, but it seems very likely that the output of silver for 1892 will fall considerably short of anticipations.

DRILLING-CONTESTS have become deservedly popular among miners and the general public throughout the Rocky Mountain region, and the interest taken in these trials usually brings together many of the best known competitive drillers. At the tournament held at the recent session of the Mining Congress at Helena, the records for both single and double-hand drilling were broken; the former by William Shea, of Montana, with $25\frac{5}{16}$ inches, and the latter by Davy and Tague, also of Montana, with $33\frac{5}{16}$ inches. The rock was granite and the time fifteen minutes in each case. Fifteen teams contested for the double-hand honors, and there were thirteen entries for the single-hand championship. Comparisons between the records made at different contests are somewhat uncertain because of variations in the hardness and toughness of the rocks drilled.

ANOTHER application of compressed air, in ventilating mines, may be through the use of the air-injector, as was perhaps foreshadowed in the experiments in ventilating the Forty-second street tunnel, New York, by Mr. Green, the inventor of the ventilating system bearing his name used on steamships. These experiments have shown that one volume of air passed through the nozzle of an injector at a pressure of five pounds above the atmosphere will induce thirty volumes of free air, as measured by a meter. The nozzle is so constructed as to offer the maximum amount of contact for the minimum volume of discharge; it takes hold of the induced air not only on the outside but also in the center or core of the jet. Apropos of this, some readers may have noticed a statement in a technical periodical to the effect that the exhaust from the compressed-air drills is disagreeable to breathe, and therefore presumably unwholesome, with the query why pure air compressed and carried through clean iron (and rubber) pipes should be distasteful. It would be hard to find a reason, unless it is that the odor of oil or wearing metal may be carried in or that the difference in temperature may be unpleasant. Perhaps it would be better to establish the fact before attempting an explanation. In most mines having power drills the latter are working at points where natural ventilation is almost inert, as at headings of long drifts, and where the mine is heated and deteriorated by respiration and the candles or lamps. In such places the exhaust from the air drills is usually a grateful relief.

PRICES of the "rarer" metals are misleading as a guide to comparisons of their actual rarity in nature or the difficulty of extracting them from their ores. These are the two points which would determine their market values if there were any demand for them on the commercial scale; but since for many of them there is no such demand as yet, the quoted prices are "fancy," that is purely arbitrary and not fixed by the law of supply and demand upon which prices of the common metals are based. Consequently it happens that, with almost no demand at all, quotations are far higher than they would be if there were a sufficient market to stimulate their production on a larger scale. Many of these rarer metals and their salts are sold only to make up sets for the museums of educational institutions or for experimental purposes, and the prices quoted are for material presumably "chemically pure," though that trade expression is not quite accurate, since dealers make another grade which they queerly call "strictly chemically pure," under which classification some very common elements, like zinc for instance, command extraordinary prices. Occasional stories have got into print about the supposed values of the rarest elements, which are often absurdly exaggerated. As a matter of curiosity it may be interesting to run over the present New York quotations for some of the rarer metals: Thallium and uranium are listed

at 20 cents per gram each, the oxide of the latter selling at $5 per pound; molybdenum, 50 cents per gram; strontium, 60 cents per gram; chromium, $1 per gram; rubidium, $2 per gram; titanium, $2.20 per gram; barium, $400 per gram; niobium and rhodium, $5 per gram; ruthenium, $5.50 per gram; cerium and erbium, $7.50 per gram; tantalum, indium, yttrium and didymium, $9 per gram; calcium, lanthanum and lithium, $10 per gram; glucinum, $12 per gram; thorium, $17 per gram; vanadium, $22 per gram; and gallium, the rarest element for which there is a regular quotation, is held at $140 per gram. Selenium is sold at $1.80 per ounce; iridium, $7 per ounce; platinum, $7 to $9 per ounce; palladium, $35 per ounce; osmium and zirconium, each $65 per ounce. Of the metals which are quoted by the pound (and of the "commercial" grade), aluminum sells at 50 to 65 cents, according to quantity and form; arsenic, 40 cents; sodium, 50 to 75 cents; tungsten, 80 cents; cadmium, $1; powdered magnesium, $4; manganese, $1.10 (or $10 per ounce for "chemically pure"); bismuth, $2.40; tellurium, $5; cobalt, $6; and potassium, $28. Comparing these prices, it will be noticed that many of the metals named are not really rare, but of very frequent occurrence, in their combined state, the price depending on the difficulty of extraction, in connection with the demand. Aluminum, for example, stands on the same plane as iron, in being one of the commonest elements and having an indefinite call for consumption, the price depending upon the cost of production and not upon the sources of the metal. Platinum, on the other hand, *is* a rare metal, but having a good market its valuation is determined by the small quantity mined rather than upon metallurgical difficulties, though the expense of getting it into merchantable shape is of course included. Then there are several elements which occur in great abundance but are difficult to reduce to the metallic state and have little or no value as metals. The elements commanding the highest prices, like gallium and thorium for instance, may be for the present regarded as mere curiosities. By computing the number of grams in a pound or a ton, and multiplying by the nominal price of the smaller unit, some ingenious newspaper men have worked out very astonishing figures. But since nobody wants a ton or even a pound of gallium, such assumed valuations are wholly fictitious.

THERE is an inviting field for the chemist in investigating the properties of a number of the so-called rarer elements, which are thus named because, there being no apparent use for them, they are seldom seen or heard of outside of the laboratory, but which are found in fairly large quantities as constituents of minerals. Some years ago, when the Black Hills tin-bearing area first came into notice, surprising additions were made to the stock of previously supposed infrequent minerals (columbite, for example), and doubtless many of these and other minerals, if searched for elsewhere, would be found to exist in much greater quantity than is imagined. The first step in the investigation would naturally be to isolate an amount of any given element sufficient for convenient experimentation, and to ascertain the metallurgical conditions affecting its reduction to the metallic state and the methods of making its salts direct from the crude mineral. Then the obvious line of study would be to seek utilizations analogous to those already found for the elements most nearly related to it. In this research, systematic experimentation may be expected to be assisted by accidental discoveries. Having found one or more useful applications, the chemist would then resume in more detail the study of the economical production of the metal and its alloys and salts. The probabilities for finding new and successful industrial applications seem, on the whole, to be much greater for these elements in their combined than in the metallic state; and it might be that while great metallurgical difficulty and expense attend the reduction of a metal to a pure form, its alloys could be cheaply obtained by reduction in connection with other metals (as illustrated by the ferromanganese manufacture), and that its salts could be easily made direct in the wet way from the crude

mineral, with reasonable cheapness for the purpose in view. Laboratory research also includes, and in usual practice begins with, a study of the chemical reactions of a given element with other elements. This leads to the constant addition of new reagents for analytical chemistry and is a decided gain. The properties of any element and its compounds having been ascertained, the most promising directions for industrial application suggest themselves. It is curious that for several of the rarer elements the only applications in use or proposed follow along similar and restricted lines. These are, most frequently, for encaustic colors in the ceramic art, as pigments and dyes, and for medicinal use; and the limitation is perhaps because it is the fashion to first look for these uses. There surely must be a far wider field, and it is strange that more attention is not given it. Believers in the teleological idea of the universe may be rather wild in theory, but the probability remains, so far as experience indicates, that there is nothing in nature without a use, if that use could only be found.

"MINES and Mining" is a stock phrase that originated with some verbose legislator and has somehow fallen into such common use that its redundancy escapes notice. It has a large sound, and has beguiled the managers of the Chicago Exposition into the snare. There are Congressional committees on "mines and mining," and lately a bill was introduced in the House to create a "Department of Mines and Mining." There is sense in "mining and metallurgy," for the words convey distinct meanings. But "mines" and "mining" in this connection are practically synonymous, and either word would fully serve the purpose of both. People speak of a "mining school" or of a "school of mines;" but who ever heard of a "school of mines and mining?"

STEEL shoes and dies for stamp-mills have been steadily gaining in popularity, and for dry crushing have long since practically supplanted cast iron ones. A steel maker wishing to ascertain experimentally the best composition of steel for such purposes, has to that end prepared sets of steel shoes and dies of various compositions, and now offers them to some mill where the different kinds can be tested comparatively and the results recorded. That is the sensible way of determining matters of this nature. A few systematic tests, in the same mill, on the same ore, and with all the conditions uniform, will throw more light on the subject than a host of desultory experiments whose results cannot be correlated.

IN large transactions iron ore is almost invariably bought on the unit basis; that is, the furnace man pays so much per unit (per cent.) of metallic iron contained, with the usual discrimination against phosphorus and sulphur. Besides these for certain uses it is also important to know the percentage of manganese present in manganiferous iron ores, for which an allowance is made if the amount is considerable; also the proportions of earthy bases (lime, alumina, magnesia) together with the silica. In good furnace work of course a close watch is kept on the character of all material used, and complete analyses are necessary. The only way to establish fair market prices for iron ores is by adopting the unit basis; but attempts to do so have been resisted by operators of small mines, especially in the South, who, having no chemist, object to the determinations being left in the hands of the ore-buyers. A simple method of avoiding all occasion for disagreement or suspicion would be to let the sampling and assaying be done by disinterested third parties, on the same plan as that followed in handling precious-metal, lead and copper ores between the mines and smelting works. Public sampling works could do this and also attend to the sales, at a small commission, which would be warranted by the more satisfactory results to both seller and buyer. It would be a great improvement on the haphazard system, or want of system, sometimes followed in the purchase of small lots of ore by guess-work.

COMMENT & CRITICISM.

NOTE.—The claims of our friends for a hearing in this department of THE ENGINEERING MAGAZINE are becoming so numerous that the Editor is obliged to request that future contributions to it be confined to the briefest limits practicable.

Response of "A Southern Engineer."

IT is not often that one finds himself engaged in a controversy where he has only to call attention to the concessions of his opponents for his own vindication. But this seems to be the advantage secured by the publication of my article entitled "Impending Disaster on the Mississippi," in the June number of this magazine. Every position assumed in that article is conceded by the critics, either directly or indirectly.

In the August number I am subjected to what the military engineer or old battery-man would call a cross-fire. Mr. Chauncey N. Dutton, Mr. H. St. L. Coppée, and Mr. T. Graham Gribble have concentrated their fire on my position; and, were my guns posted on a levee, I would undoubtedly have to limber to the rear. But they are posted, fortunately, where I can advance my lines instead of retiring; and I have to thank my adversaries for leaving me so much open field.

First, let us consider the testimonials in favor of dikes produced by Mr. H. St. L. Coppée. They are furnished by General Comstock of the United States Army, and include a statement by "James H. Wilson" in relation to the Yellow River in China. But it can hardly be claimed that they are conclusive; and, so far as they prove anything, they prove the solidity of the ground on which my argument was based. I said that building dikes helped to raise the bed of a stream. General Comstock does not deny this, but, after investigation, says that they cannot raise it more than eight inches in a hundred years. Of course that depends upon the amount of sediment that a river carries,—an exceedingly variable quantity in different rivers. But eight inches in one hundred years are nearly seven feet in one thousand years. Is there nothing startling in this computation for men who are engaged in an engineering work which is expected to serve the remotest posterity? Possibly not, for there is a general disposition abroad to let posterity look out for itself; but we may be sure that, if dike-building can raise the bed of a river seven feet in the first thousand years, it can raise it twice seven feet in the next thousand, for the process is one that grows by what it feeds on. As the current is retarded, the deposit of sediment becomes annually greater and greater.

What, too, does the statement of General James H. Wilson signify? This gentleman was in China, and, having heard that Abbe Huc had visited a portion of the Yellow River at a point where he found the bed of the stream higher than the adjacent country, he set himself to making some independent observations. But he confesses that he had no instruments "except a hand-level, sextant, and tape-line, and could take no accurate levels across embankments, bed of stream, fore-shores, and adjacent plains." This is a confession that his observation was worthless; and as if to make his conclusions as inconsequential as possible, he fails to state that his surveys were made upon the ground observed by Abbe Huc. Nobody presumes that the bed of the Yellow River is higher than the adjacent country among the mountains or high lands, and in taking testimony on any subject we do not accept the evidence of the men who have not seen, but of the men who have seen. The statement of Abbe Huc must stand, therefore, until a complete survey of the river, made with no ulterior purpose of defending bad engineering principles, proves he was mistaken.

The arguments of Mr. Dutton, and Mr. Gribble too, not less than the argument of Mr. Coppée, are peculiar for the concessions made in favor of my position. Mr. Dutton admits that the channel of the river is too long, and that it might be advantageously shortened; and Mr. Gribble evidently sees that the beds of all rivers must rise as the mouths are pushed outward into the ocean further and further from the source. Supposing that there has been no subsidence of the ocean, the bed of the Mississippi River is now about 300 feet higher at the mouth of the Ohio than it was in the far-back geological era when its mouth was at the present location of the Cairo, 600 miles inland. But how was the bed raised? Mr. Dutton says that it was raised by a "cataclysm"! But there is no evidence of a "cataclysm," and there has been no necessity for one. The entire Mississippi valley below Cairo could be a product of the river and the winds, the former bringing down sediment from the interior and depositing on its bed and along its banks, and the latter distributing it over the adjacent country. Only give those two active carriers the time and they could create the whole valley, and there is little doubt that they have created it without the aid of an energetic "cataclysm." But they have now done enough; and it is my proposition that they shall no longer have the coöperation of the dike-building contractor who carts his dirt to the shore in order that the river may wash it off into its bed.

Let me amplify a little on the proposition for shortening the bed of the stream, contained in my original article, and accepted by Mr. Dutton as gingerly as though it might cut out a contract for dike-building. Following the sinuosities of the stream, the distance from the Gulf of Mexico to Cairo is between 1100 and 1200 miles. Following an air line, it is only 600 miles. I will submit myself to discipline if my figures are incorrect here. I am like General Wilson surveying the Yellow River in China, and have left my instruments at home. But I am nearly enough right. Say that between 1100 and 1200 miles is the length of the river that we have, and that about 600 miles would be the length of the river that we might have were the channel made to follow a direct line from Cairo to the gulf. Then let us suppose that the plans of the Mississippi engineers were turned to the straightening of the bed, and see what would follow.

The present average fall of the river is between three and four inches to the mile, enough to give a current in all ordinary stages of water of something less than two miles per hour. Were the distance made only 600 miles, the fall would be about six inches to the mile, and this would about double the capacity of the channel for disposing of its surplus water. The velocity of the current would be nearly doubled for temporary service in carrying off floods, and its scouring force for perpetual service in keeping down the bed of the stream would be vastly increased. The bed would still rise somewhat as the mouth is pushed out still further into the Gulf of Mexico; but the very winds, which are apt to be prettily heavily laden with fine dust in that section of the Union, would always keep the banks above the danger of overflow.

Is the undertaking too vast when it is proposed to make a straight cut between Cairo and the gulf? Dike-builders ought not to think it a very large undertaking. They have managed to expend nearly $100,000,000 already on a mere foundation that would be washed away in less than a half generation were it abandoned. To save the money already expended it will be necessary to expend hundreds of millions and finally thousands of millions more, for no man in his senses will ever hold that dike-building can come to an end so long as it remains a dependence.

Let us see about the magnitude of the work of making a straight cut, or rather of making two straight cuts,—for the Red River wants a channel of its own, and it would have had a good one before this time at very little cost through Lake Pontchartrain were it not for the supreme folly of the transcendently scientific engineer. The straight cut for the Mississippi should lead directly southward, or nearly south-

ward, from the mouth of the Red River through the connected bayous and streams of Louisiana, and the opening of this section would entail the chief part of the expense. Nature itself will do most of the work from one end of the line to the other, after the engineers have opened a way through the obstructions.

Let us have this subject clear. We cannot hope to master the forces of nature by setting ourselves in opposition. We must observe what nature is trying to do and go about facilitating her work. More than once she has seen the danger impending over New Orleans and has tried to avert the catastrophe by pushing her floods out to the gulf by way of Lake Pontchartrain. But she will finally get tired of seeing herself misapprehended and foiled; and on one of those terrific and fateful days that only occur once or twice in a century she will let herself loose on the devoted city, and wash it into the Gulf of Mexico.

A SOUTHERN ENGINEER.

New York and its Docks.

IN a recent number of the ENGINEERING MAGAZINE, I took occasion to criticise the position assumed by Mr. William Nelson Black, in regard to the dock system of New York, and have been surprised to see him entirely ignore the essential factors of the argument referred to by me. The fact that municipal ownership and management of docks exist in Liverpool, without any of the features which he attributes to the system in New York; that the finest docks in the world are maintained on the same plan in Rotterdam; coupled as these instances are, with the additional fact that the graphic photographs of squalid surroundings which he has taken on the New York shore and credited to municipal ownership of the water front, can be easily matched, if not exaggerated, across the river, where private ownership of the gateways of commerce exists in its most approved style; all these pieces of evidence so contradictory to his line of argument, should at least have led him to do a little searching for their origin, if only to get the proof that they did not affect his primary assertion.

Mr. Black jumps to the conclusion that the great warehouses have arisen in Brooklyn because they have been forbidden in New York, which he supposes to be a direct detriment to New York and a gain correspondingly for Brooklyn. Now, as a matter of fact, if warehouses would pay as well as other uses of the docks, they would certainly be erected there by their lessees, just as great buildings are put up all over the city on leasehold land. But warehousing is entirely too extravagant a use to be made of New York soil, and New York merchants consequently do their warehousing on cheaper ground in Brooklyn; just as they long ago gave up storing their goods in the lofts of their stores, and turned those lofts into offices, which paid better as soon as there were enough people to need the space for that use. Of late years, even Brooklyn land has become too valuable for some kinds of storage. Within the last ten years, for instance, such stuff as crude iron (scrap or pig) which has small value for its bulk, has gone to still more remote spots for storage, such as Communipaw or Perth Amboy. No goods are now stored in New York city (nor would they be under any conceivable circumstances) the dealings in which are ordinarily in bulk; that is, that are bought and sold and shipped away to internal distributing points for the most part by entire cargoes or large fractions of cargoes. Only those goods are stored in New York, which are broken up into small jobbing parcels, and turned over perhaps into various shapes without actual remanufacture; and this kind of storage merchants do not care to have done away from their salesrooms, since the handling involved is practically the same thing as that in a retail shop. For such storage, a warehouse on the river front, when all the other conditions of trade require that the salesrooms shall be in the center of the island, would be utterly useless and would have no patronage whatever. Consequently, the warehouses go where they are really needed and can be most economically maintained; but the city of New York and its citizens are no more injured than are the bankers

who have their offices on Wall street, because Central Park has been located uptown instead of near the Battery.

As to the trucking business and exterior streets, which Mr. Black bemoans so bitterly as a supposed burden upon the trade of New York, if he had made a little inquiry among New York merchants—not retail shop-keepers—he would have revealed a state of affairs by him apparently unsuspected. Whoever it was that originally devised an exterior street, it is the merchants who have made the demand for its widening, for a portion of its length at least. The truth is that what we really want with our water-front is simply a place where we can receive our goods, and from which we may take them away as quickly as possible; not a place where we may store them. We, therefore, want the utmost facilities for trucking, this being one of the agencies which we employ as the best devised so far for the handling of our business.

When it comes to the miserable surroundings that have grown up around our steamer-wharfs, that is simply a result of land speculation, such as has driven all west-side improvement off the Boulevard to the side streets; merely because we have made it profitable to hold the land comparatively idle pending possible advance in value, in consequence of which the improvement and the increased value which follows has gone elsewhere and thus the goose has been killed which lays the golden eggs. A similar effect is seen around all large railway stations, or just one block back in Brooklyn from the warehouses which Mr. Black illustrates; while it is fairly caricatured on the flats which lie back of the private water-front of the Erie Railway in Pavonia, or the magnificent possessions of the Stevenses in Hoboken. In passing this point, I would remark that when Mr. Black adduces the ownership of the Astors of so much of the land adjoining New York piers as conclusive evidence that it is only the "blight" under which that land lies which prevents its improvement, that he is clearly unaware that it is the fixed policy of the Astor estate not to improve. That estate owns a great many buildings, but they are for the most part buildings which have been erected by lessees on their land which have come to the estate on the expiriration of the leases; or if not, nearly always buildings which it has been absolutely necessary to put up to take the place of buildings acquired, as I have just stated, and which have become useless by reason of dilapidation or antiquated style. Instances of this may be found in the new Astor office-building on Wall street, almost the last of its kind to go up in the vicinity, or in the new Holland House, which took the place of the old Astor mansion; for in these locations, unless the building was directly fitted to its locality, it was little better than no building at all, a thing which cannot be said of the neighborhood bordering upon the water-front, where an infinite variety of structure will pay the trifling expense and taxes for which we permit landowners to hold so much of New York city out of use.

E. J. SHRIVER.

RESPONSE BY MR. BLACK.

REALLY, I must confess that I never discovered any "essential factors" in Mr. Shriver's communication, and had forgotten both the writer and his arguments before he was half read. I merely glanced over his article, and seeing that it had been prepared by one of those queer fellows who are so firmly grounded in what they call principles that they are impregnable to facts, dismissed it from my mind. But since he is persistent, and returns to the charge after the idiotic water-front system of New York has been so fully exposed that even the Dock Commissioners themselves and their engineers would wish it to the devil could they only find some other equally fat places, his case will have to be considered.

Mr. Shriver mentions Liverpool as a city that illustrates the beneficial influences of municipal thimble-rigging about docks and warehouses. Well, what of Liverpool? It is a city that had grown to have nearly a half-million inhabitants while the people had character enough about them to build their own docks and warehouses. But the men of Liverpool abdicated and sold out, the old women

came to the front, and the city is the same old city still. London, Glasgow, Manchester all ahead, while Liverpool has fallen to fourth-class. Yet it has the only good harbor on the English coast, and should have a population of millions.

And Rotterdam! Where's Rotterdam? When we consent to borrow our political institutions from Europe, we shall not imitate little towns that have lost their rating through lack of ability to get ahead. Enough, said, then, about either Liverpool or Rotterdam.

Let us see what is the next thing Mr. Shriver has to say. Ah! it is here; and it is another joke. The warehouses have gone to Brooklyn, he says, because New York property is too expensive for such cheap service as warehousing. The water-front property in eight Brooklyn wards, covering a frontage of about five miles, is assessed at $21,000,000 in round figures. The water-front property of the eight lower wards of New York, covering the same frontage and including the piers in private hands, is assessed at $14,000,000. The Brooklyn property was worth next to nothing thirty-five years ago, and the New York property was worth more than it is to-day. What do these figures mean? I shall not explain their meaning because Mr. Shriver would not understand the explanation, and other men will not need it.

Is there anything more? Oh, yes, here it is, and it is what might have been expected. Mr. Shriver credits the dilapidated buildings along the water front, not to municipal tenure of the piers and obstructing exterior streets, but to land speculation. To appreciate the complete subtlety of this joke, land speculation must be understood to mean land speculations elsewhere to the detriment of water-front land; and even then it will be pretty far fetched. But it will do. Unless the property was suitable for a gin-mill, you have hardly been able to give away a piece of water-front property along the New York water front since Brooklyn began her race for the lead.

But here Mr. Shriver seems to break away from the water-front, and to launch into the political ethics of the single-taxers on general principles. He is still nothing, however, if not facetious. He takes occasion to berate the Astors for not improving their property, and carries either the charge or the inference, or both, that they let other people improve it in order that they can get possession of the improvements when the leases expire. Why, certainly, the Astors are not fools. Their property must be improved, or they would soon fall into bankruptcy; and if they can find other persons who can see a profit in making the improvements they would be very silly if they did not accept their terms. The Astors' money is no better than other men's money for distribution among house carpenters and masons. Henry George's "single-tax" scheme of confiscation was never better than a craze, and it has now fallen from even that distinction.

WILLIAM NELSON BLACK.

"Truth Seeker" Unsatisfied.

READERS of THE ENGINEERING MAGAZINE will remember that Mr. T. Graham Gribble, in his well-written articles entitled "The World's Future Highway," stated that the depth of water in the rapids above Niagara Falls was twenty feet at the crest. I ventured to object to the statement in a communication, and said that it was impossible that a river which is only a mile wide and twenty-five feet deep where it flows at the rate of six miles an hour, opposite Black Rock, could retain a depth of anything approaching twenty feet where it is still nearly a mile wide, and flows at the rate of sixty miles an hour just above the falls. But Mr. Gribble is not satisfied, and, in the August number, states that the rapids were sounded in the year 1827 by the *Michigan* when she went over the falls, and found to be twenty feet deep.

I hardly know how to meet this statement. I was born and raised within sight of the cloud that always hangs over Niagara Falls, and was fed on the local traditions of the place. But I never heard of the *Michigan*, which I suppose to be the name of a water-craft of some kind. I have heard that an American Indian once went over the falls on a dark night in his birch-

bark canoe, and never knew it until a flash of lightning, revealing the face of the cataract above him, told of the perilous leap that he had made. I have heard, too, of an old schooner, freighted with a bear, a catamount and some other American products of a kindred description, having been turned adrift above the falls and allowed to float down the rapids. This may have been the *Michigan;* but I never heard that the animals took soundings.

Does Mr. Gribble intend to have us understand that there was a crew aboard the *Michigan* and that they deliberately took soundings, and lived to make their report? Or does he only mean to say that the craft drew twenty feet of water and must, therefore, have had a twenty-foot channel for its passage?

To the first question no answer is required. To the second no answer had better be attempted, because they did not build vessels drawing twenty feet of water on the great lakes as long ago as 1827. Center-boards were used and a vessel drawing the half of twenty feet was a prodigious craft in the shallow lake harbors long after 1827. But the passage of a well-built vessel over the falls without breaking up would prove nothing. The stratified rocks that form the bed of the Canadian rapids are doubtless worn almost as smooth as the apron of a flume; and a stanch craft, half upheld by the terrific rush of waters around and beneath her, might be pushed down the whole extent of rapids without going to pieces.

We happen to know something of the depth of the rapids above the American Falls. Many years ago, somewhere in the fifties, if memory holds its seat, the ice broken from the shores of Lake Erie was brought down by the west winds one spring in such vast quantities that it formed a forty mile long pack at the lower end of the lake, and the flow of water was so obstructed that the river fell about three feet at its source. What was the result? The American Fall was nearly dried up. A gentleman living in the village on the American side drove over in his carriage to Goat Island. This is proof that there cannot be more than a foot or so of running water in the American rapids, though, to see it dashing and dancing along, white as a snow-drift, you might imagine it to be of any depth you pleased.

Mr. Gribble thinks it not impossible to take soundings all along the crest of Niagara Falls, and, with the truly engineering instinct, he says that he would like to take the contract. I will give him something easier. The rapids below the falls are not nearly so swift as the rapids above the falls, and when the Suspension bridge was first opened, an attempt to take soundings was made. A twenty-five pound lead attached to a chain was dropped from the bridge. An instant after it struck the water and disappeared it rose to the surface again a hundred feet below, and, in attempting to pull it back the engineers broke the chain. Now let Mr. Gribble undertake the contract for recovering that lead. It will be of use to him when he undertakes to make soundings along the crest of the cataract.

TRUTH SEEKER.

Mr. Wisner and Cape Hatteras.

THE comment of Mr. George Y. Wisner in the last number of this magazine upon my paper on "Engineering Off Cape Hatteras," convinces me that Mr. Wisner does not yet fully understand my theory and the principle upon which this proposed method is designed to operate. He gives an instance of the enormous force of ocean waves upon a monolithic mass of concrete weighing 2600 tons, as an argument that my proposed method owing to less specific weight per square foot of exposed surface will not even withstand a moderate gale of wind. This proves my theory that we must not depend upon specific gravity alone in a locality like this, but must adopt additional means of safety.

I would refer Mr. Wisner to page 516 of the July number, wherein I especially considered the importance of the above facts as of vital interest in such a problem. I state there specifically that "A rigid, solid material would be easily destroyed by the action of the swell before there would be time to support and hold it in its position";

but an elastic and porous fabric will withstand similar attacks for a much greater length of time," etc. If a monolith of 2600 tons can be removed what chance have we in this case if we depend upon specific weight of material, but to equal seismic force and create a solid rocky island of many thousands of tons in weight thus to secure immunity against the ocean's fury? This being impossible, we must call upon other forces for assistance. Mr. Wisner will admit that the base of the proposed fascine breakwater will be quickly imbedded within and by the sands of the shoal, and it is to this adhesion of the base of the structure to the shoal, and the flexibility and porosity of the upper structure to minimize the force of the waves until silting has completely covered the structure, that we can depend much more for security than the specific weight alone. In this connection I would state that there is an efficient and inexpensive method of proving the correctness of this proposition which the government could adopt should its officers desire to satisfy themselves upon its practicability.

Mr. Wisner also considers the ravages of the teredo as a serious drawback for this undertaking. For his information I would state a practical proof against this assertion. All wooden vessels engaged in our coasting trade are devoid of any metal sheathing to their bottom; whereas those trading in southern climes are generally protected in this manner to avoid worming; a fact too well known among maritime people. Commercial economy is the most sensitive proof in matters of this kind. Had the site for this project been located in the Gulf of Mexico or adjacent waters, where, no doubt, Mr. Wisner has experienced the destructive attacks of these pests, the writer would have hesitated before advocating such a structure, but on our Northern coast the attacks of the teredo are not to be dreaded in this structure. The little damage that might result from the action of these worms will be more than compensated for by the natural growth of the willows. The cold waters of this coast are detrimental to the propagation of the teredo.

In reference to the physical conditions of this locality, there still exists a great lack of definite information. It is supposed by many that rock formation must closely underlay the surface of these shoals to keep them in their position. In the absence of facts I investigated the geological rock formation of the adjacent coastline, with reference to the pitch of their strata towards the Atlantic seaboard, with the aid of the best authorities obtainable, and an approximation of these results would develop rock at least 2000 feet below these shoals; but a boring on the point of Cape Hatteras probably would give more positive information upon this subject. I feel convinced that the trend of the coast-line and its outlying shoals, are the results of the peculiar run of the currents in these localities.

J. W. WALTERS.

New York, August 9, 1892.

An Attempt to Teach Practical Mechanics.

THE article by Mr. John T. Hawkins in this magazine for July on "Intuition in Machine-Designing" treats of a subject of vital importance. In June, 1891, the Mechanical Engineering Teachers' Association was formed at Columbus, Ohio, to discuss such subjects as Mr. Hawkins presents. The belief that too little is done towards a direct training of natural inventive capacity in engineering schools is held by some of these teachers and doubtless will be expressed at the coming meeting in Rochester. To accept the remedy proposed by Mr. Hawkins, that of doing without the more ornamental higher mathematics and giving the time to the cultivation of what a New Englander would call mechanical "gumption," seems to some a lowering of the ideal of a "Mechanical Engineer" that has been established by the larger colleges. A college which would lower its requirements in mathematics would be judged as being in a state of decline by critics who would not consider whether the high mathematical ideal set up was producing as great a percentage of successful engineers as might be expected.

It has been said that this country has no

intermediate schools, each small college trying to ape a complete university. So it seems that all engineering courses are endeavoring to train mathematical engineers, of whom we certainly need a few, and are ignoring the demand for a host of more practical constructive engineers. It ought not to be possible for a young man without inventive capacity and general mechanical "gumption" to pass a mechanical-engineering course solely on the strength of mathematical aptitude, but that such cases are possible every graduate knows. To have the higher mathematics excluded from all our technical courses would indeed be a shame, but it cannot be true that if this study is good for a few it must be good for all, unless mechanical engineering cannot be taught without its use. It would seem that some colleges would find both honor and profit for their students in following a course more largely technical.

An attempt in this direction is being made at the Kansas State Agricultural College. This is one of the land-grant colleges under the act of 1863, and enrolls nearly 600 students; two-thirds of whom are young men.

The course followed is a general course, based on the industries, and while all young men are obliged to engage in mechanical work in the shops and receive some technical instruction, no separate mechanical course is provided, nor are mechanical engineers graduated.

A young man may spend ten terms of the twelve in the four-years' course in the shops if he chooses. At graduation the young man is equipped with a general education beyond what is usual in technical courses, with mathematics enough to handle mechanics without the calculus, and with a considerable shop-practice extending over four years. A post-graduate course covering from twelve to eighteen months' continuous work in the purely technical subjects is provided, with more than usual liberty in the shops for the construction of original designs. It cannot be said that principles are neglected and mere "finger wisdom" substituted, but the freedom of post-graduate work allows for the training of the natural bent of each individual beyond the possibilities of undergraduate work.

As Mr. Hawkins suggests, the "making a study of constructive problems occupies the highest place and is given the greatest time." The work demanded is more nearly what an employer would demand, both as to quality and time, and it is expected that no violent change of habits will be necessary as the student goes out into such positions as are usually filled by technical graduates. Another point raised by Mr. Hawkins is that of "leaving the young man at graduation as an 'M. E.'" I believe such a degree to be a handicap frequently the employer expecting too much of the graduate on account of the assumption of a title which should come only with experience. In three neighboring States are three technical schools; the one having the most severe course and requirements confers the degree of "B. S." at graduation, and "M. E." as a third degree after four years' experience and further study. Another confers "M. E." as a second degree, while the third graduates "M. E.'s in four years.

O. P. HOOD.

Professor of Mechanics, Kansas State Agricultural College.

CURRENT TECHNICAL LITERATURE.

TO THE READER.—This catalogue is compiled from the technical periodicals of the United States, England and France. If you were to subscribe only for those of most importance, it would cost you over $500.00 a year. If you were to undertake to read them, you would do nothing else from year's end to year's end. To subscribe for THE ENGINEERING MAGAZINE and get the benefit of this catalogue costs you but $3 a year. To glance over those departments of the catalogue in which you are chiefly interested, and decide which of the articles listed are of real value to you, requires but fifteen minutes of your time each month. If you have taken the precaution to purchase a stock of our coupons, it will take you but ten minutes more to fill out, say a dozen, and enclose them in an envelope to THE ENGINEERING MAGAZINE COMPANY, WORLD BUILDING, NEW YORK. No letter-writing is required. A stamped envelope does the work. In return you will receive the dozen articles desired, though they may be published at a dozen different points in the world.

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In the body of the index the initials of the papers quoted are given, and these can be readily identified by the alphabetical list of periodicals below. Other abbreviations are: Ill=Illustrated; w=words.

THE AMERICAN PRESS.

A S .....Age of Steel. *w.* $3. St. Louis.
A An....American Analyst. *f.* $1 per year. N. Y.
AA.....American Architect. *w.* $6. Boston.
A Ar.....American Artisan. *w.* $2. Chicago.
A C J....Am. Chemical Journal. *b-m.* $4. Baltimore.
A D.....American Druggist. *m.* $1.50. New York.
A G L J..Am. Gas Light Journal. *w.* $3. New York.
A G.....Am. Geologist. *m.* $3.50. Minneapolis.
A J Phar.Am. Journal of Pharmacy. *m.* $3. Phila.
A J R A..American Journal of Railway Appliances. *m.* $2 per year. New York.
A M .....American Machinist. *w.* $3. New York.
A M & I W.American Manufacturer and Iron World. *w.* $4 per year. Pittsburg.
A A A....Annals of Am. Academy of Political and Social Science. *b-m.* $6. Philadelphia.
A H.....Annals of Hygiene. *m.* $2 per year. Phila.
A E .....Architectural Era. *m.* $3. N. Y.
A R.....Architectural Record. *q.* $1. New York.
A Rev....Architectural Review. *s-q.* $5. Boston.
A & B....Architecture and Building. *w.* $6 N. Y.
A .....Arena. *m.* $5 per year. Boston.
A & N J..Army and Navy Journal. *w.* $6. New York.
A & N R..Army and Navy Register. *w.* $3 per year. Washington.
At M.....Atlantic Monthly. *m.* $4 per year. Boston.
B J C....Boston Journal of Commerce. *w.* $3 per year. Boston.
B & W...Builder and Woodworker. *m.* $1. N. Y.
B P .....Bulletin of Pharmacy. *m.* $1. Detroit.
C A.....Calif. Architect. *m.* $3. San Francisco.
C E N....Canadian Electrical News. *m.* $1 per year. Toronto.
C & B...Carpentry and Building. *m.* $1. New York.
C M.....Century Magazine. *m.* $4 per year. N. Y.
Ch.....Chautauquan. *m.* $2. Meadville, Pa.
C E. .....Colliery Engineer. *m.* $2. Scranton, Pa.
C.....Compass. *m.* $2 per year. New York.
Cos.....Cosmopolitan. *m.* $3 per year. New York.
Cr.....Crank. *m.* $1.25 per year. Ithaca, N. Y.
D E.....Domestic Engineering. *m.* $1. Chicago.
D J.....Drainage Journal. *m.* $1. Indianapolis.
D Jour...Druggists' Journal. *m.* $1. Chicago.
E A.....Electrical Age. *w.* $3 per year. New York.
E E N Y..Electrical Engineer. *w.* $3 per year. N. Y.
E R N Y..Electrical Review. *w.* $3 per year. N. Y.
E W.....Electrical World. *w.* $3 per year. N. Y.
E & R ...Electricity and Railroading. *m.* $1 per year. Boston.
Eng .....Engineer. *s-m.* $2 per year. New York.
E M J....Engineering and Mining Journal. *w.* $4 per year. New York.
E Mag ...Engineering Magazine. *m.* $3. New York.
E M.....Engineering Mechanics. *m.* $2. Phila.
E N.....Engineering News. *w.* $5 per year. N. Y.
F & M R..Financial and Mining Record. *w.* $3. N.Y.
F W.....Fire and Water. *w.* $3 per year. N. Y.
F .....Forum. *m.* $5 per year. New York.
G & F....Garden and Forest. *w.* $4 per year. N.Y.
G G M...Goldthwaite's Geographical Magazine. *m.* $2 per year. N. Y.
G R.....Good Roads. *m.* $2 per year. N. Y.
I A.....Inland Architect. *m.* $5 per year. Chicago.
I R W...India Rubber World. *m.* $3 per year. N.Y.
I S F....Industry. *m.* $2 per year. San Francisco.
I Age....Inventive Age. *s-m.* $1. Washington.
I T R....Iron Trade Review. *w.* $3. Cleveland.
J A C S..Journal of the American Chemical Society. *m.* $5 per year. N. Y.
J A E S..Journal of the Association of Engineering Societies. *m.* $3 per year. Chicago.
J F I.....Journal of the Franklin Institute. *m.* $5 per year. Philadelphia.
J M S I..Journal of the Military Service Institution. *b-m.* $4 per year. Governor's Island, N. Y. H.
J N E W.Journal of the N. E. Waterworks Association. *q.* $2. New London, Conn.
L M.....Leather Manufacturer. *m.* $3. N. Y.
L E.....Locomotive Engineering. *m.* $2. N. Y.
M & B...Manufacturer and Builder. *m.* $1.50. N. Y.
M R.....Manufacturer's Record. *w.* $4. Baltimore.
M N.....Mechanical News. *s-m.* $1.50. New York.
M & El...Mechanic and Electrician. *w.* $2 per year. St. Louis.
Met W...Metal Worker. *w.* $2 per year. N. Y.
Min .....Minerals. *m.* $1 per year. N. Y.
M S P....Mining and Scientific Press. *w.* $3 per year. San Francisco, Cal.
M S R....Mining and Scientific Review. *w.* $2 per year. Denver.
M I T....Mining Industry and Tradesman. *w.* $3 per year. Denver.
Misc.....Miscellaneous.
N B .....National Builder. *m.* $3. Chicago.
N C B...National Car Builder. *m.* $2. N. Y.
N A R...North American Review. *m.* $5. N. Y.
N W.....Northwestern Architect. *m.* $3. Minneapolis.
O M.....Overland Monthly. *m.* $3 per year. San Francisco.
P L.....Pacific Lumberman, Contractor, and Electrician. *w.* $3. San Francisco.
P..... ..Paving and Municipal Engineering. *m.* $1 per year. Indianapolis.
P Era...Pharmaceutical Era. *s-m.* $2. Detroit.
P R.....Pharmaceutical Record. *s-m.* $1.50. N. Y.
P S N...Popular Science News. *m.* $1. Boston.
P S.....Power-Steam. *m.* $1 per year. N. Y.
P E. .....Practical Electricity. *f.* $2 per year. Boston.
P A.....Progressive Age. *w.* $3. New York.
R A E J..Railroad and Engineering Journal. *m.* $3 per year. New York.
R C J....Railroad Car Journal. *m.* $1 per year. N.Y.
R G .....Railroad Gazette. *w.* $4.20 per year. N. Y.
R A.....Railway Age. *w.* $4 per year. Chicago.
R M M..Railway Master Mechanic. *m.* $1. Chicago.
R R.....Railway Review. *w.* $4 per year. Chicago.

R P.....Registered Pharmacist. *w.* $1. Chicago.
R & T...Roofer and Tinner. *m.* $1 per year, N. Y.
S V.....Safety Valve. *m.* $1 per year. N. Y.
San.....Sanitarian. *m.* $4 per year. Brooklyn.
S Era... Sanitary Era. *m.* $1 per year. N. Y.
S P.....Sanitary Plumber. *s-m.* $1. N. Y.
S M Q.. School of Mines Quarterly. $2. N. Y.
Sc.....Science. *w.* $3.50 per year. New York.
Sea.....Seaboard. *w.* $2 per year. N. Y.
S A.....Southern Architect. *m.* $1. Atlanta.
S E.....Stationary Engineer. *w.* $2. Chicago.
S.....Stone. *m.* $2 per year. Indianapolis, Ind.
S R G....Street Railway Gazette. *w.* $5. Chicago.
S R N. ..Street Railway News. *w.* $3. N. Y.
T Q ....Technology Quarterly. $2. Boston.
T A I E E.Transactions American Institute of Electrical Engineers. *m.* $5 per year. N. Y.
W E.....Western Electrician. *w.* $3. Chicago.

THE FOREIGN PRESS.

C T J...Chemical Trade Journal. *w.* 12*s.* 6*d.* per year, post-paid. Manchester, Eng.
C G.... ..Colliery Guardian. *w.* 27*s.* 6*d.* per year, post-paid. London.
C R.....Contemporary Review. *m.* $4.50 per year, New York. London.
D. ..... Discovery. *w.* 8*s.* 8*d.*, post-paid. London.
E E L....Electrical Engineer. *w.* 17*s.* 4*d.* per year. post-paid. London.
E P.....Electrical Plant. *m.* 6*s.* per year, post-paid. London.
E R L....Electrical Review. *w.* 21*s.* 8*d.* per year, post-paid. London.
El.. .....Electrician. *w.* 24*s.* post-paid. London.
El P.....Electricien. *w.* 25 *fr.* post-paid. Paris.
E L.....Electricity. *w.* 6*s.* 6*d.*, post-paid. London.
Eng L... Engineer. *w.* 36*s.*, post-paid. London.
E.....Engineering. *w.* 36*s.*, post-paid. London.
F R.....Fortnightly Review. *m.* $4.50 per year. New York. London.
G E M...Gas Engineers' Magazine. *m.* 6*s.* 6*d.* per year, post-paid. Birmingham, Eng.
G W.....Gas World. *w.* 13*s.*, post-paid. London.
G C.....Génie Civil. *w.* 45 *fr.*, post-paid. Paris.
I C B....Illustrated Carpenter and Builder. *w.* 8*s.* 8*d.* per year, post-paid. London.
I E.....Indian Engineering. *w.* Rs. 18 per year, postage extra. Calcutta.
I L.....Industries. *w.* 32*s.*, post-paid. London.
Inv.....Invention. *w.* 28*s.*, post-paid. London.
I.....Iron. *w.* 30*s.* per year, post-paid. London.
J G L....Journal of Gas Lighting. London.
K.....Knowledge. *m.* 6*s.*, post-paid. London.
M.....Machinery. *m.* 9*s.*, post-paid. London.
M E.....Marine Engineer. *m.* 7*s.* 6*d.* per year, post-paid. London.
M W.....Mechanical World. *w.* 8*s.* 8*d.* per year, post-paid. London.
M I.....Moniteur Industriel. 3 times a week. 40 *fr.* per year, post-paid. Paris.
N C.....Nineteenth Century. *m.* $4.50 per year. New York. London.
P Eng...Practical Engineer. *w.* 10*s.* per year, post-paid. London.
R N.....Railway News. London.
R U M...Revue Universelle des Mines. *m.* 40 *fr.* per year, post-paid. Paris.
S R.....Sanitary Record. *m.* London.
W R.....Westminster Review. *m.* $4.50 per year. N. Y. London.

ARCHITECTURE.

5383. Iron Mill Buildings. Ill. John W. Seaver (R G–July 15.) 3700 w.

5403. Modern Architecture. III. Ill. P. Planat (A A–July 16.) 1500 w.

5404. The International Congress of Engineers and Architects in Italy. Alfredo Melani (A A–July 16.) 2700 w.

*5433. Prevention and Extinction of Fire in Theaters. Ernest E. A. Woodrow (Misc.) 6000 w.

*5435. Decoration. Andrew Wells (Misc.) 2900 w.

5465. Modern Architecture. Ill. IV. P. Planat (A A–July 23.) 1600 w.

5466. The Philadelphia Bourse Competition. The Architects of Philadelphia (A A–July 23.) 1700 w.

*5504. The Building Stone Industry of the United States. I. Geo. P. Merrill (S–July.) 2400 w.

*5507. Decorative Stone-Cutting. Louis H. Gibson (S–July.) 2200 w.

5596. New Methods in Heavy Timbering. Ill. Frederic G. Corser (E N–July 28.) 1600 w.

5676. Circle on Circle. Ill. I. (C & B–Aug.) 1600 w.

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5808. Sub-Contracting. Peter Long (P D–July.) 1600 w.

5854. The relation of the Architect to the Workman. C. R. Ashbee (A & B–July 30.) 5000 w.

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5396. Shall There Be a Road Exhibit at Chicago? R. W. R. (E M J–July 16.) 1700 w.

*5440. Cyclone Wind Pressures. Ill. Rigis de Chagne (Eng L–July 8.) 750 w.

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*5463. Bridges and Bridge Builders. Ill. Peter MacQueen (Cos-Aug.) 5500 w.

5487. The Civil Engineer and the Railroad. Editorial (R G–July 22.) 1200 w.

5496. Street Subways for Pipes and Wires at Nottingham, England. A. Brown (E N–July 21.) 1400 w.

†5498. The Continuous Girder as a Tipper. C. H. Lindenberger (Misc.) 1000 w.

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*5505. Mississippi River Improvement. Ill. D. M. Grisson (S–July.) 2750 w.

*5523. From Holborn to the Strand. Ill. Editorial (Eng L–July 15.) 1700 w.

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*5858. The Nicaragua Canal. (I S F–Aug.) 2500 w.

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*5417. The Electricity Supply Business in London. Editorial (El–July 8.) 2000 w.

*5418. Suspended *vs.* Stationary Coil Galvanometers. W. E. Ayrton and T. Mather (El–July 8.) 1100 w.

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*5770. Recent Advances in the Electrolytic Refining of Copper. I. Bertram Blount (E P–Aug. 1.) 900 w.

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†5812. Notes on the Blast Furnace. Ill. John Hartman (J F I–Aug.) 4000 w.

*5833. A Useful Hardening Process (Misc.) 2000 w.

*5863. Exposé de la Théorie Cellulaire des Propriétés de l'Acie. II. M. L. Baclé (G C–July 23.) 5000 w.

MILITARY ENGINEERING.

*5390. Les Canons Français à Tir Rapide. (G C–July 2.) 600 w.

*5419. Modern United States Artillery. XV. Ill. (E–July 8.) 2200 w.

*5454. Firing the Justin Projectile. Ill. (Misc.) 2400 w.

*5519. The Bruce Electrical War Balloon. (Eng L–July 15.) 700 w.

†5565. The Theoretical Instruction of Gunners. James Chester, Samuel M. Mills, G. N. Whistler, Frank W. Hess, E. T. C. Richmond, H. J. Reilly, W. A. Simpson, C. D. Parkhurst, E. A. Millar, and Charles Morris. (Misc.) 15,000 w.

†5566. A Study of the Effects of Smokeless Powder in a 57 mm. Gun. Ill. Laurence V. Benet (Misc.) 6000 w.

†5567. Department of Chemistry and Explosives, U. S. Artillery School. Ill. Willoughby Walke (Misc.) 4000 w.

†5568. The Effect of Accelerating and Retarding Winds Upon Projectiles. Ill. G. N. Whistler (Misc.) 3000 w.

†5569. A Proposed Design for a New Ballistic Target. John C. W. Brooks (Misc.) 800 w.

†5570. Field-Artillery, Its Organization and Its Rôle. Charles D. Parkhurst (Misc.) 10000 w.

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*5669. Modern United States Artillery. XVII. Ill. (E–July 22.) 3100 w.

5695. Electric Welded Projectiles. H. P. Maxim (E R N Y–Aug. 6.) 2200 w.

†5729. La Fabrique Nationale d'Armes de Guerre à Herstal. Ill. Léon Castermans (R U M–July.) 6000 w.

*5773. Modern United States Artillery. XVIII. Ill. (E–July 29.) 3500 w.

*5862. Matériel du Canon de 15 Centimètres à Tir Rapide, de 45 Calibres, Système Schneider. Ill. L. de Thunimont (G C–July 23.) 5900 w.

MINING.

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Industry. John H. Jones (M R–July 15.) 2000 w.

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5398. Spartanburg, S. C., Gold Fields. George E. Ladshaw (E M J–July 16.) 750 w.

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5401. Flathead Coal Basin, Montana. Herbert Wood (E M J–July 16.) 850 w.

5405. Utah's Past, Present and Prospective Contributing to the Wealth of the Country. Ill. Wm. Nelson (F & M R–July 16.) 2300 w.

5406. Park City Mining District of Utah. Ill. (F & M R–July 16.) 4000 w.

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5408. Frisco. Will C. Higgins. (F & M R–July 16.) 1000 w.

5409. Tintic District, Utah. Ill. George Ryan (F & M R–July 16.) 1800 w.

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*5425. Mine Accidents and Their Prevention. II. Charles de Sinner (C G–July 8.) 2600 w.

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*5441. High-Speed Locomotives. Charles Rous-Martin (Ibid.) 1900 w.

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*5561. Voyage du President de la Républicque dans l'Est. Description des Nouvelles Voitures-Salons de la Compagnie de l'Est. Ill. Max de Nansouty (G C–July 9.) 6500 w.

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*5434. Gas and Electric Light Considered from a Hygienic Point of View. Editorial (E L-July 8.) 1300 w.

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*5603. Influence du Logement sur la Santé des Habitants. E. Cacheux (G C-July 16.) 3000 w.

*5665. Sewage and Its Purification. Ill. C. A. Burghardt (E E L-July 22.) 800 w.

*5675. Trap Venting. Dankmar Adler, Wm. E. Hoyt, and others (N W-July.) 2800 w.

*5766. Southampton Sewage Precipitation Works and Refuse Destructor. William B. G. Bennett (C G-July 29.) 550 w.

*5830. Notes on the Sanitary Condition and Necessities of Pittsburgh. Crosby Gray (A H-Aug.) 3600 w.

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*5579. Angle of Crank for Maximum Velocity of Piston. Editorial (E-July 15.) 2500 w.

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5609. The Chimney. Frank J. Roth (S E-July 23.) 2500 w.

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*5649. Condensation in Steam-Engine Cylinders During Admission. Ill. I. Thomas English (I L-July 22.) 2000 w.

*5659. The Design of Locomotive Smokestack and Exhaust Nozzles. Ill. (N C B-Aug.) 1200 w.

†5702. Smoke Prevention. Report of Special Committee of the Engineers' Club of St. Louis (J A E S-June.) 18,000 w.

*5771. Condensation in Steam Engine Cylinders During Admission. Thomas English (I L-July 29.) 2000 w.

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5623. The Electric Storm of July 16, 1892. W. Finn (E E N Y–July 27.) 1600 w.

*5653. Notes on the Double Differential Relay for Use on Submarine Cables. Ill. Edward Raymond-Barker (E R L–July 22.) 1600 w.

5690. Modern American Telegraphic Apparatus. V. Ill. F. W. Jones (E E N Y–Aug. 3.) 1200 w.

†5732. La Téléphonie le Long des Chemins de Fer Belges à Petite Section. Ill. Emile Piérard (R U M–July.) 6000 w.

*5769. A Letter by Gauss Bearing on the Discovery of the Telegraph. E. C. Gauss (E L–July 29.) 500 w.

*5864. Electrodynamométre Giltay pour la Mesure des Courants Téléphoniques. Ill. J. A. Montpellier (El P–July 30.) 800 w.

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5400. Statistics of Southern Industrial Progress. Ill. II. Wm. B. Phillips (E M J–July 16.) 3500 w.

*5414. Thomson's Law of Economy. E. T. Carter (El–July 8.) 1500 w.

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*5509. Modern Power Plants. II. F. Riddell (S–July.) 1300 w.

*5511. New England's Future. Burton H. Allbee (S–July.) 1600 w.

5513. Transmission of Heat Through the Walls of Buildings. I. Leicester Allen (Met W–July 23.) 1700 w.

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5637. Chimneys. V. Ill. Wm. H. Bryan (A S–July 30.) 600 w.

*5645. Maxim's Flying Machine. Editorial (P Eng–July 22.) 1600 w.

*5647. Experiments with Inflammable and Explosive Atmospheres of Petroleum Vapor. I. J. H. Heck (P Eng–July 22.) 1750 w.

*5656. The Petroleum Trade of the Caucasus (C T J–July 23.) 2000 w.

*5658. The Protection of Wire Ropes. Herbert Cheesman (Eng L–July 22.) 800 w.

*5670. The Priestman Oil Engine, from an American Engineering Standpoint. Coleman Sellers (E–July 22.) 1800 w.

*5671. Three Aspects of Engineering. Editorial (E–July 22.) 2500 w.

5682. A National Physical Laboratory. Arthur G. Webster (E W–Aug 6.) 4400 w.

†5699. Methods of Modern Petrography. Lea McI. Luquer (S M Q–July.) 3000 w.

†5731. Les Principes de l'Agriculture Moderne. J. Pyro (R U M–July) 7000 w.

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*5798. Sur l'Aluminum. M. Balland (M I–July 19.) 600 w.

*5809. Black Walnut Orchards as an Investment. Editorial (Misc.) 2300 w.

†5810. A Motor Without Fuel and the Second Principle of Thermo-Dynamics. Ill. Herman Mehner (J F I–Aug.) 6300 w.

*5822. The Influnce of Impurities on Copper. Editorial (Eng L–July 29.) 1700 w.

5838. Modeling in Clay (Met W–July 30.) 1900 w.

5839. Transmission of Heat Through the Walls of Buildings. II. Ill. Leicester Allen (Met W–July 30.) 1800 w.

5840. History of Asbestos (Met W–Aug. 6.) 1700 w.

5849. The Engineering Schools of the United States. XVI. Ill. (E N–Aug. 4.) 400 w.

*5869. The Early Manufacture of Rubber Web. Ill. (I R W–Aug. 15.) 1500 w.

NEW BOOKS OF THE MONTH.

[For the convenience of readers any American books will be supplied at publishers' prices by The Engineering Magazine Co. Foreign books, 25 per cent. extra.]

Alheilig=Recette, Conservation et Travail des Bois ; Outils et Machines-Outils Employés dans ce Travail. Paris : Gauthier-Villars et fils. [16mo, paper, 198 p., 2 *fr.* 50*c.*]

Annuaire des Mines, de la Métallurgie, de la Construction Mécanique, et de l'Electricité. Paris : Bernard & Cie. [8vo,856 p.]

Apgar, Austin C.=Trees of the Northern United States : Their Study, Description, and Determination. New York : American Book Co. [12mo, cloth, 224 p., $1.]

Bunau-Varilla, P.=Panama : le Passé, le Présent, l'Avenir. Paris : G. Masson. [4to, paper, 179 p.]

Bonney, G. E.=Induction Coils : a practical manual for amateur coil-makers. London : Whittaker. [8vo, 228 p., 3*s.*]

Besson, A.=Etude de Quelques Produits Nouveaux Obtenus par Substitution dans les Composés Haloïdes des Métalloïdes ; Etude de Quelques Combinaisons Nouvelles du Gaz Ammoniac et de l'hydrogène Phosphoré avec les Composés des Métalloïdes. Paris : Carré. [4to, paper, 75 p.]

Butler, W. P.=Irrigation Manual : containing useful information and tables appertaining to irrigation by artesian waters in North and South Dakota. Huron, S. D.: Huronite Printing House. [8vo, cloth, 204 p.]

Chandler, Jos. Everett.=The Colonial Architecture of Maryland, Pennsylvania, and Virginia. Boston : Bates, Kimball & Gould. [Folio, $12.]

Carpenter, R. C. = Text-Book of Experimental Engineering. New York : Wiley. [8vo, cloth, 825 p., $6.]

Dodge, J.=Modern French Artillery. New York : Wiley. [4to, half morocco, 458 p., $20.]

Fulminite (La) : Son Origine, Ses Effets, Son Emploi, Ses Avantages. Paris : Kugelmann. [8vo, paper. 48 p.]

Flather, J. J.=Dynamometers and the Measurement of Power. New York : Wiley. [12mo, cloth, 221 p., $2.]

Harrison, J. L.=The Great Bore : A Souvenir of the Hoosac Tunnal. North Adams, Mass.: Advance Job-Print Works. [24mo, cloth, 80 p., 50c.; paper, 25c.]

Johnson, Emory R.=River and Harbor Bills. Philadelphia. American Academy of Political and Social Science. [8vo, paper, 129 p., 50c.]

Jones, Dwight Arven.=A Treatise on the Negligence of Municipal Corporations. New York : Baker, Voorhis & Co. [8vo, sheep, 656 p., $6.]

Klein, E.=Elements of Machine Design for the Use of Draughtsmen and Students of Engineering. Bethlehem, Pa.: E. G. Klose. [Cloth, $6.]

Montchoisy, de=Cours Pratique et Théorique de Machines à Vapeur, Professé à l'Ecole Supérieure de Maistrance de la Marine. Paris : Challamel. [8vo, paper, 818 p., 18 *fr.*]

New York City. Laws Relating to Buildings. Edited by W. J. Fryer. Including directory of Architects in N. Y. City, Brooklyn, Jersey City, and Newark. New York : The Record and Guide. [8vo, cloth, 295 p., $2.]

Nicholl, T. J.=Useful Information and Data for Travelers, Railway men and Mechanics. Chicago : Danks & Co. [16 mo., paper, 69 p.]

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Weiller, L. and Vivarez, H.=Traité Général des Lignes et Transmissions Electriques. Paris : G. Masson. [8vo, paper, 836 p., 18 *fr.*]

Weyl, Walter E., Luce, Robert, Hall, Bolton, and others.=Equitable Taxation. Six Essays. With introduction by Jonathan A. Lane. New York : Crowell. [12mo, cloth, 94 p., 75 c.]

Wellington, A. M., Penniman, W. B. D., and Baker, C. W.=The Comparative Merits of Various Systems of Car Lighting. New York : Engineering News. [16mo, cloth, 303 p.]

MACHINE-SHOP NOTES.

Conducted by Albert D. Pentz.

TEN years ago Mr. Scobber was one of the most distinguished inventors in his line of industry. To-day his name has entirely ceased to enrich the Patent-Office records. Mr. Scobber still lives and his environment is much the same as for the past twenty years. But, while he is still in the prime of his life, and vigorous, his genius no longer creates with its old-time skill. People who have known Mr. Scobber all these years tell an interesting and perhaps unique story of his inventive life. Up to sixteen years ago he was not suspected even by his most intimate associates of possessing mechanical inventive power in any degree. But at that time he suddenly began to invent ingenious and practical devices of very advanced character. These devices carried the goods he was engaged in building forward beyond those made by any competitor of the concern that employed him. Mr. Scobber is and has been the manager of a factory during this whole period of twenty years. In this capacity about sixteen years ago he concluded that the goods which the factory made could be improved in design. So he inaugurated an experimental department and a young machinist who was recommended to him was put to work in it. It took more than a year to get the experiments completed and the first patents issued, but they were worth the time and the expense. Then, one after another, for ten years he patented some of the best things in his art. The concern, appreciating his efforts, gave him stock and made him a director for eight successive years. Mr. Scobber's financial success in the concern aroused the jealousy of the young mechanic and thenceforward he was found hard to manage. The obstinate fellow actually claimed all the inventions as his own and became notoriously uncomfortable. He was given more pay but that made him worse. At last the concern was forced to discharge him. These circumstances perhaps disgusted Mr. Scobber with inventions; anyway he has made no more of them. The mechanic to-day is a celebrated electrician.

THE writer is of the opinion, founded on his own experience, that the quality of steel instruments is impaired by their being heated in the lead bath prior to being quenched for hardening. The deteriorating effect noticed is impaired strength and an inferior cutting and lasting quality in edges. In other terms, steel so heated seems to lose "life," elasticity and tenacity. The fracture seems duller and the crystals seem coarse, in some cases resembling a casting or rather overheated steel. In the case of files the coating of paste may preserve them from contact to some extent, but not absolutely. It is suggested that this subject be taken up in some form and thoroughly investigated in one of the engineering schools. It is not impossible that there will be found to be a union of some character between the molten lead and the steel at some temperature.

THE mechanical engineers who at this moment are successful, are those who have an extensive knowledge of machinery as it is practically made and practically designed. The details of the making of machinery, and the resources and limitations of the machine-shop, are more necessary to successful design than the higher mathematics are. Kinematics is certainly taught in the machine-shop more thoroughly than in the school, although most practical men do not know it by that name. Its applications there also are all of a practical character. What a movement cannot do properly is quite as essential a thing to know as what it can do possibly. Absurd applications of mechanical powers and movements are to-day largely a specialty of those without shop-practice.

The engineers again who are *most* successful are those who, in addition to practice, have the higher school training, and it is the desire of all who appreciate the advantages of abstract science that it shall be taught in the engineering schools, together with as thorough practical applications to concrete elements as possible. Schools of this kind should teach other sciences as thoroughly as they teach mathematics—that of motion in particular.

WHEN a twist-drill catches, and halts, it springs, elongates, catches deeper, and breaks. This is especially true in the use of such drills for the enlargement of holes and where their points are not embedded in the metal. This is why a flat drill operates better in many such cases.

THE big strong machinist owns but one hammer and that weighs nearly three pounds. He uses that hammer for chipping small key-seats, and the small chisels break continually. A better metal than steel will have to be found to make chisels for this combination of strong man and heavy hammer unless, indeed, he is made to see the beauties of a lighter hammer.

AS we pass into the era of perfected small tools, evolution is already advancing toward automatic perfecting machines for all kinds of purposes. The possibility of such tools for isolated cases, such as the pin machine, the Jacquard loom, the automatic screw machine, and the perfecting newspaper press, was demonstrated many years ago. But the universal application of perfecting tools was doubted and denied until recently, and even now there are those who, while they may not deny the mechanical possibility of automatic machines for every manufactured thing, will not admit that for many articles such tools can be made to pay. Those who doubt are, however, fewer each year, and that they are less confident in their assertions is apparent in each succeeding statement they make. The causes for the increased confidence that is felt in the final manufacture of all things by the employment of perfecting tools are four: First, as an art or an article is studied for its uses alone, it is always found that it either can be modified, simplified and cheapened to the advantage of the user, or that it can be remodelled to extend and perfect its operations without additional cost of manufacture. Second, as an art or an article is studied to adapt it to the resources and limitations of manufacture, it often is found necessary to modify it and possibly to cheapen it by such modification to an astonishing degree, and without at all reducing its value or efficiency. In fact, in some cases such efficiency is materially advanced by such modification. Third, as the tools and practice of manufacture are studied to adapt them to an art or an article, such tools are continually being made more efficient and simplified in design, and such practice is continually made more economical and more effective. Further than this—in the search for mechanical efficiency that is ever increasing, and which is ever rewarded by the production of improved devices and more perfect methods, one tool is evolved out of existence and a new one takes its place, revolutionizing, in some cases, the whole art. Fourth, the present tendency of like interests to associate for economical production and to prevent destructive competition eventually will bring together under one management the production of all similar goods. This cheapens production by increasing the quantities made in one place. It permits of the construction of tools and machinery for the whole, which could not economically be made for each one of a dozen fractions, as well as reducing the expenses of a dozen plants of power and tools, and a dozen corps of management to one. The incorporation of all the small factories of a country which make one class of goods, each into one great industry, is a wonderful step in advance, economically and mechanically. But it is probable that those who have labored hardest to associate industries have builded differently and wiser than they knew. There is in the sum of these four statements the facts to indicate with certainty, that all articles can be better manufactured by the use of advanced

tools, and perfecting machines are the most advanced of tools. Again, by making the whole quantity of an article that is used in a country, all in one place and by one concern, there are found the conditions that permit of the economical designing, construction and use of special perfecting machines to make any article of commerce.

THE value of a punching-press is great in any kind of a machine-shop, whether the work is jobbing or tools. The cheapness with which a good ordinary punch and die can be made surprises those who do not know. It pays to make a die for 50 of any small piece that can't be sheared out, and of some kinds of pieces it will pay for 10. Most workmen try to make such a die too well. All that is needed for an emergency, is a piece of good steel rough planed to fit the bolster. If fifteen cents be saved in the quality of the steel, however, three dollars worth of work may go into the fire and water with it and fail to come out again. In drilling the die shape out there is no economy in using a drill smaller than No. 10, unless there is a width in the die too narrow to admit it. This shape should be drilled close to the outline and so deep that the point of the drill only is imbedded while the die is lying flat on the drill-press table. Then the holes should be finished through with the die lying on a wedge—a shingle will do. This is the simplest way of getting a regular clearance below the shearing edge. A finicky workman is out of place making this kind of die. A smart youngster or a quick-actioned bench-hand will either of them make an ordinary punch and die fit for such a job as indicated for three dollars time-expense.

THE first job the Finlander had given him was to make two thousand posts to support the trunnions on some kind of an electrical instrument long since forgotten. These posts were perhaps one-and-one-half inches high and each consisted of a balled top, one inch in diameter, and a stump the same size, which was cylindrical one-eighth of an inch from its seat, and which was joined to the ball by a concave fillet, the junction being about half an inch in diameter. This stump was drilled and tapped in the center of its seat as a means to hold it down and to hold it to the lathe in the making of it. The material was "red metal," the very free composition of copper, zinc, and lead from which telegraph instruments then were made. We had never before seen a Finlander work, so we watched him closely, but found nothing differing from our practice until he began to finish the balls and other outside shapes. He used an ordinary speed-lathe and of course he held the pieces on a screw solidly fastened to a true mandrel attached to the live spindle. He also used the usual gas-pliers faced with leather to remove his finished pieces from the mandrel without scarring them. The tail-stock spindle was one of these furnished with a lever and an adjustable stop, so that the tool he had in it to cut his pieces to an exact length should not possibly be forced beyond its position so as to spoil them. Now this Finlander placed the round vertical hole in the stock of the tool-rest exactly below the center line of the lathe and just one inch from the face of the mandrel he was to attach the pieces to in turning them. Into this vertical hole he fitted the shank of a narrow table, the top of which came nearly as high as the under part of the rough pieces before they were turned. It will be seen that this small table could be turned within its hole in the tool-rest stock easily by hand. This table was cast-iron and upon it he fastened a cast-iron tool-guide, which was nothing but a narrow plate with a groove planed into its top face just wide enough to fit the tools to be used and as deep as was right to place the points of these tools as high as the centers of the lathe. He had adjustable collars on his hand-tools as well as handles; so that when they were placed in the groove the collars would locate them the proper distance in by striking the end of the tool-guide and the handles were used to turn the whole device with. There was a roughing tool with a narrow round point; a sizing tool, narrow and square-pointed, two fillet tools and

two for the cylindrical part of the stump All there was to be done in making these posts was to pick up these tools one after another in proper order, place them within the guide, hold them firmly and swing the table until it struck a stop. When all the tools were used the piece was shaped and there was nothing further to be done but to polish it with emery-paper and do another one. I am afraid to state my recollection of the limited number of seconds required to make one of these operations of shaping and polishing these posts from the castings, but it was a surprise to us and our respect for the arts in Finland grew greatly until we discovered that he had worked five years in a great instrument-factory in Chicago.

To P. D., Washington, D. C.: We believe you can buy castings for a small steam-engine in New York somewhere, but if you have not mechanical experience nor any lathe you will have great difficulty in finishing it. Our advice, since you ask it, is, don't try to make one. If you want such an engine buy it ready-made or have it made for you by some one who knows how. This will be much cheaper, and the pleasure you anticipate in the making of it will not balance the disgust you will feel for the dirt you will get on your person and clothing. An amateur may be able to write a successful book, play, or poem, but no amateur ever can make a good steam-engine at the first trial. Mechanical work is a serious affair. You cannot correct proofs and thus eliminate errors, for every mistake counts one for the scrap-box. If you could see all the partly-finished engines in this broad land that have been begun by novices and now lie rusting in obscure holes and corners never to be touched again, you would know why we say—don t!

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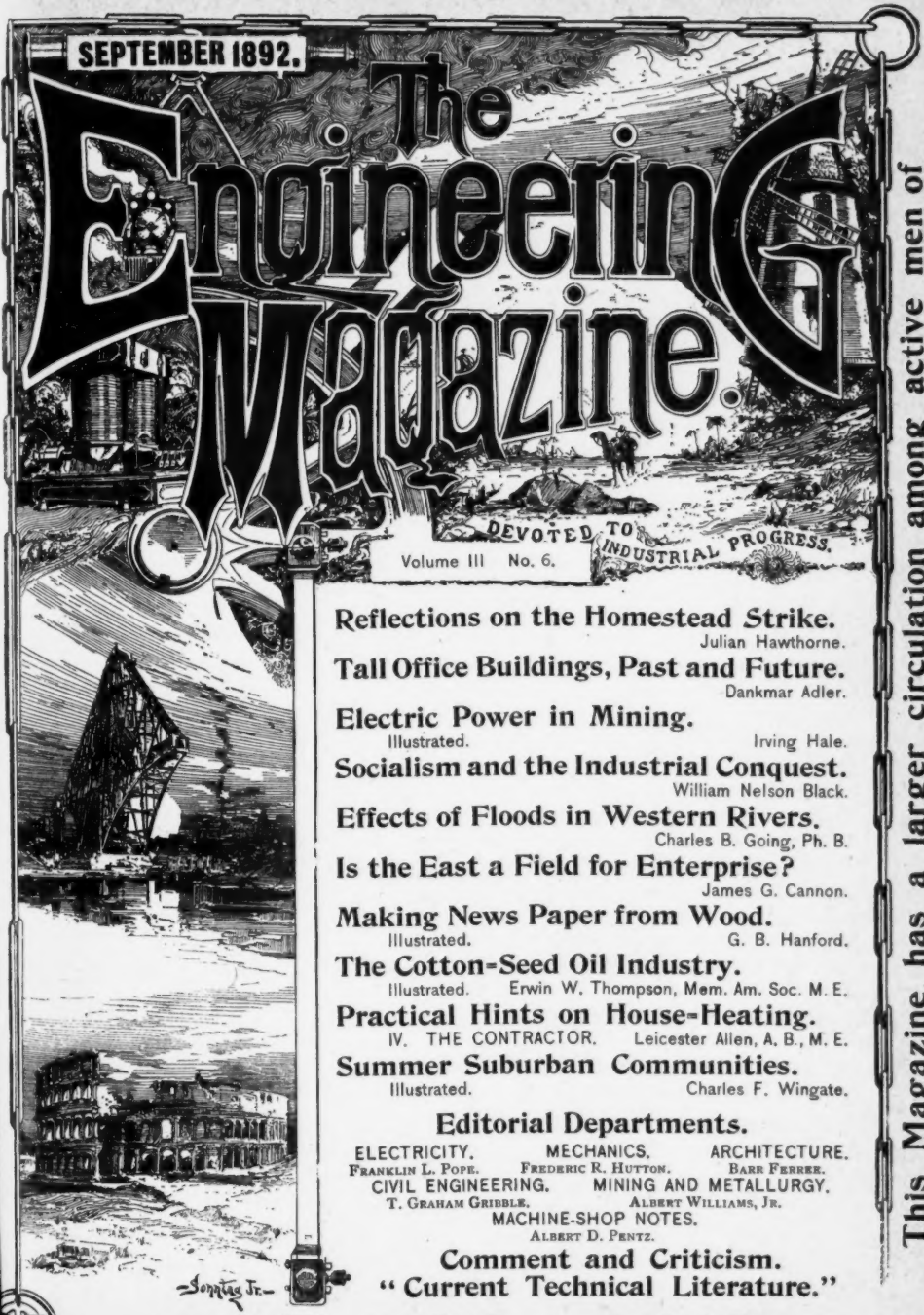

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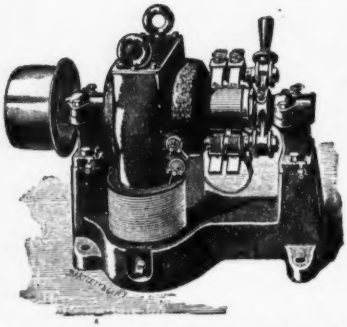

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A WORD OF INTRODUCTION.

JULIAN HAWTHORNE, who contributes this month some "*Reflections on the Homestead Strike*," is the distinguished son of America's greatest novelist. He has been selected to treat the present subject because, as a literary man and a student of economic and sociological principles, he may be expected to be free from both the interests and the prejudices that affect the capitalist upon one hand and the labor-sympathizer on the other.

WILLIAM NELSON BLACK, who writes of "*Socialism and the Industrial Conquest*," is an old resident of New York who fought through the war of the rebellion to maintain the Union, who for many years has been a student of our constitutional history and the fundamental principles for which the founders of our free government contended. As a close observer of the changes wrought by the war and a discriminating critic of the growing tendency toward State Socialism, his paper will be found especially valuable to the men of this generation whose recollection does not extend back so far.

CHARLES B. GOING, who writes on "*The Effects of Floods in Western Rivers*," was born in New York in 1863, was graduated from the Columbia School of Mines, and for ten years has lived in Cincinnati, employed in connection with chemical industries and municipal improvements. Incidentally the work of a corporation of which he is president has led him into a study of the phenomena of Western rivers.

JAMES GRAHAM CANNON, who asks "*Is the East a Field for Enterprise?*" was born at Delhi, N. Y., July 26, 1858, and went to New York in 1872. He was fourteen years in the Fifth Avenue Bank, of which he is still a Director, and in 1890 became Vice-President of the Fourth National Bank. He is also a trustee of the Franklin Savings Bank and a member of the Chamber of Commerce and other important organizations. He has been a frequent writer upon financial topics, and his articles have attracted no little attention.

LEICESTER ALLEN, a mechanical engineer and expert on heating and ventilation of high standing, concludes this month his series of "*Practical Hints on House-Heating*."

CHARLES F. WINGATE, who writes of "*Summer Suburban Communities*," introducing a large number of illustrations showing what comforts and conveniences are within the reach of families of moderate means not far from the great Eastern cities, has done much through his work to secure improvements in sanitary conditions in New York city.

IRVING HALE, who contributes a paper on "*Electric Power in Mining*," graduated with the highest honors at West Point in 1884. Served six years at the United States Engineer School and as Instructor of Engineering at the Military Academy. He resigned in 1890 to engage in electrical engineering, and is now with the General Electric Company in the Mountain District, Denver, Col. He is a member of the Colorado Scientific Society, American Society of Mining Engineers and other technical societies.

ERWIN W. THOMPSON, who describes "*The Cotton-Seed Oil Industry*," was born in Georgia in 1859, and was graduated in mechanical engineering at Cornell University. In 1882 he organized a company and built a cotton-seed oil mill in Georgia, since which time he has sustained an important relation to this industry. He is the inventor and patentee of several machines and processes now used in the cotton-seed oil business, and is now manager of the largest companies engaged in this industry. He has contributed to several technical journals and to the "Transactions of the American Society of Mechanical Engineers."

GEORGE B. HANFORD, who writes of "*Making News Paper from Wood*," was born in New York in 1854; went West and was educated at the College of Wisconsin; engaged in business with his father in Ohio; went to New York in 1880 and entered the paper trade with a firm whose mill he entered after a time, becoming familiar with the mechanical department. He is now in charge of the entire manufacturing business in the paper department of the Ticonderoga (N. Y.) Paper and Pulp Co.

DANKMAR ADLER, who writes of "*Tall Office Buildings—Past and Future*," to be followed by at least another paper on this branch of architecture, is a member of the eminent firm of Chicago architects, Adler & Sullivan.

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Campbell & Zell Co., Baltimore, Md.
Chester Steel Castings Co., Phila., Pa.
Crown Smelting Co., Chester, Pa.
E. Horton & Son Co., Windsor Locks, Conn.
Geo. V. Cresson, Philadelphia, Pa.
Ohio Pipe Co., Columbus, Ohio.
Pennsylvania Steel Co., Steelton, Pa.
Pratt & Letchworth, Buffalo, N. Y.
R. D. Wood & Co., Philadelphia, Pa.
Robert Poole & Son Co., Baltimore, Md.
Standard Steel Casting Co., Thurlow, Pa.
Wheeler Condenser and Eng. Co., 92 Liberty St., N.Y.
Chrome Steel Works, Brooklyn, N. Y.
Walker Manufacturing Co., Cleveland, Ohio.

Chains.

Washburn & Moen Mfg. Co., Worcester, Mass.

Chain Belting.

Jeffrey Mfg. Co., Columbus, Ohio.
Link Belt Engineering Co., Phila., Pa.

Chemists.

Mariner & Hoskins, 81 S. Clark St., Chicago, Ill.
Pittsburgh Testing Laboratory, H. & C., Pittsburgh.

Chucks (All Purposes.)

The E. Horton & Son Co, Windsor Locks, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

Clutches, Friction.

Geo. V. Cresson, Philadelphia, Pa.
Moore & White Co., Philadelphia, Pa.
J. S. Mundy, Newark, N. J.
Robert Poole & Son Co., Baltimore, Md.
Volney W. Mason & Co., Providence, R. I.
Walker Manufacturing Co., Cleveland, Ohio.

Coal Mining Machinery.

Beckett Foundry & Machine Co., Arlington, N. J.
Fraser & Chalmers, Chicago, Ill.
Griffith & Wedge Co., Zanesville, Ohio.
C. W. Hunt Co., 45 Broadway, N. Y.
Ingersoll-Sergeant Drill Co., 10 Park Pl., N.Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Niagara Steam Pump Works, 34 Dey St., N. Y.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Sullivan Machinery Co., Chicago, Ill.

Concentrators and Pulverizers.

Copeland & Bacon, 85 Liberty St., N. Y.
Frisbee-Lucop Mill Co., 145 Broadway, N. Y.
Beckett Foundry and Machine Co., Arlington, N. J.
Fraser & Chalmers, Chicago, Ill.
Gates Iron Works, Chicago, Ill.
Sturtevant Mill Co., Boston, Mass.

Condensers, Jet.

Conover Mfg. Co., 95 Liberty St., N. Y.
Deane Steam Pump Co., Holyoke, Mass.
Wheeler Condenser and Eng. Co., 92 Liberty St., N.Y.

Condensers, Surface.

Edw. P. Allis Co., Milwaukee, Wis.
Wm. Baragwanath & Son, Chicago, Ill.
Gordon Steam Pump Co., Hamilton, Ohio.
Guild & Garrison, Brooklyn, N. Y.
R. D. Wood & Co., Philadelphia, Pa.
Wheeler Condenser & Eng. Co., 92 Liberty St., N. Y.

Conduits, Electrical.

New York Insulated Wire Co., 649 Broadway, N. Y.

Consulting Engineers.

D. Ashworth, 108 Fourth Avenue, Pittsburgh, Pa.
Geo. H. Burpee, 136 Liberty St., N. Y.
Charles H. Davis, 120 Broadway, N. Y.
Dr. Willis E. Everette, Tacoma, Washington.
Ed. N. Kirk Talcott, 57 Broadway, New York.
Geo. L. Colgate, Roanoke, Virginia.
James S. Harlow & Co., Pittsburgh, Pa.
John W. Hill, Cincinnati, Ohio.
Meier & Foster, St Louis, Mo.
E. P. Jennings, Ironwood Mich.
Frederic Chisoln., Denver, Colorado.
Thomas C. Clarke, 1 Broadway, N. Y.
Wolcott C. Foster, 52 Broadway, N. Y.
T. G. Gribble, 76 Broad St., N. Y.
C. T. Gooding, Tucson, Arizona.
A. W. Jacobi, 136 Liberty St., N. Y.
Julian Kennedy, Pittsburgh, Pa.
William Kent, Times Building, N. Y.
A. Leofred, Quebec, Canada.
Rob't E. McMath & Sons, St. Louis, Mo.
Frank Nicholson, Phœnix, Arizona.
E. E. Olcott, 18 Broadway, N. Y.
Albert D. Pentz, Elizabeth, N. J.
Pattison Brothers, 135 Broadway, N. Y.
Pittsburgh Testing Laboratory, H. & C., Pittsburgh.
Pond Engineering Co., St. Louis, Mo.
Rafter & Dodgson, Rochester, N. Y.
Horace See, 1 Broadway, N. Y.
John A. Seely, 10 Cortlandt St., N. Y.
Isaac A. Smith, Oriel B'ld'g, St. Louis, Mo.
T. Wain-Morgan Draper, 45 Broadway, N. Y.
Geo. Y. Wisner, Detroit, Mich.

Contractors' Supplies.

Bucyrus Steam Shovel and Dredge Co., Bucyrus, O.
Cook Well Co., St. Louis Mo.
Copeland & Bacon, 85 Liberty St., N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Link-Belt Engineering Co., Phila., Pa.
H. J. McKeown, Cincinnati, O.
J. S. Mundy, Newark, N. J.
John Souther & Co., Boston, Mass.

Conveying Machinery.

Brown Hoisting and Conveying Co., Cleveland, O.
Frick Company, Waynesboro, Pa.
C. W. Hunt Co., 45 Broadway, N. Y.
Jeffrey Mfg. Co., Columbus, O.
John A. Roebling's Sons Co., Trenton, N. J.
Lane & Bodley Co., Cincinnati, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Link Belt Engineering Co., Phila., Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

Corliss Engines.

Edw. P. Allis Co., Milwaukee, Wis.
Beckett Foundry and Machine Co., Arlington, N. J.
M. C. Bullock Mfg. Co., Chicago, Ill.
Fishkill Landing Machine Co., Fishkill, N. Y.
Fraser & Chalmers, Chicago, Ill.
Frick Company, Waynesboro, Pa.
Hooven, Owens & Rentschler Co., Hamilton, Ohio.
Webster, Camp & Lane Machine Co., Akron, O.
Robt. Wetherill & Co., Chester, Pa.

Corrugated Iron.

Merchant & Co., Phila., Pa.
N. & G. Taylor, Philadelphia, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

Cornice Work, Galvanized Iron.

Kinnear & Gager Co., Columbus, Ohio.
W. H. Mullins, Salem, Ohio.

Cranes.

Copeland & Bacon, 85 Liberty st., N. Y.
R. D. Wood & Co., Philadelphia, Pa.
Southwark Foundry and Machine Co., Phila., Pa.
Walker Manufacturing Co., Cleveland, Ohio.
Yale & Towne Mfg. Co., Stamford, Conn.

Crusher Plates.

Chrome Steel Works, Brooklyn, N. Y.

Crushers, Ore, Phosphate Rock.

Edw. P. Allis Co., Milwaukee, Wis.
Beckett Foundry and Machine Co., Arlington, N. J.
Copeland & Bacon, 85 Liberty St., N. Y.
Fraser & Chalmers, Chicago, Ill.
Frisbee-Lucop Mill Co., 145 Broadway, N. Y.
Gates Iron Works, Chicago, Ill.
Griffith & Wedge Co., Zanesville, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Robert Poole & Son Co., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.
Chrome Steel Works, Brooklyn, N. Y.

Damper Regulators.

Mason Regulator Co., Boston, Mass.
Standard Thermometer Co., Peabody, Mass.

Desks.

A. H. Andrews & Co., Chicago, Ill.
Derby & Kilmer Desk Co., New York and Boston

Diamond Drills.

M. C. Bullock Mfg. Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., 10 Park Pl., N.Y.
Sullivan Machinery Co., Chicago, Ill.

Dies.

E. W. Bliss Co., Limited, Brooklyn, N. Y.
Crescent Steel Co., Pittsburgh, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

Die and Drill Steel.

Crescent Steel Co., Pittsburgh, Pa.
Wm. Jessop & Sons, Limited, 91 John St., N. Y.
Chrome Steel Works, Brooklyn, N. Y.

Drawing Instruments.

A. S. Aloe & Co., St. Louis, Mo.
Keuffel & Esser Co., 127 Fulton St.. N. Y.
Theo. Alteneder & Sons, Philadelphia, Pa.
Queen & Co , Philadelphia, Pa.

Dredging Machines.

Bucyrus Steam Shovel and Dredge Co., Bucyrus, O.
J. S. Mundy, Newark, N. J.
Marion Steam Shovel Co., Marion, Ohio.
Osgood Dredge Co , Albany, N. Y.
Robert Poole & Son Co., Baltimore, Md.

Drills, Rock and Coal.

M. C. Bullock Mfg. Co., Chicago, Ill.
Diamond Prospecting Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., 10 Park Pl., N.Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Oil Well Supply Co., Pittsburgh, Pa.

Drills, Metal Working.

W. F. & J. Barnes Co., Rockford, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio.
The E. Horton & Son Co., Windsor Locks, Conn.
Lodge & Davis Machine Tool Co., Cincinnati, Ohio.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Niles Tool Works, Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Drop Forgings.

Audubon Machine Works, New Haven, Conn.
Billings & Spencer Co., Hartford, Conn.

Drop Presses.

E. W. Bliss Co., Limited, Brooklyn, N. Y.
Walker Manufacturing Co., Cleveland, Ohio.

Drop Hammers.

E. W. Bliss Co., Limited, Brooklyn, N. Y.

Dynamos.

Audubon Machine Works, New Haven, Conn,
Belknap Motor Co., Portland, Me.
Eddy Electric Mfg. Co., Windsor, Conn.
Jeffrey Mfg. Co., Columbus, Ohio.

Electric Railway Supplies.

J. Jones & Son, 39 Vesey St., N. Y.
Railway Equipment Co., Chicago, Ill.

Electrical Instruments.

J. Jones & Son, 39 Vesey St., N. Y.
Audubon Machine Works, New Haven, Conn.
Eddy Electric Mfg. Co., Windsor, Conn.
Standard Thermometer Co., Peabody, Mass.
Weston Electrical Instrument Co., Newark, N. J.

Electrical Rubber Goods.

The B. F. Goodrich Co., Akron, Ohio.
Home Rubber Co., Trenton, N. J
Newton Rubber Co., Boston, Mass.

Elevators, Steam, Hydraulic, Electric.

Morse, Williams & Co., Philadelphia, Pa.
Otis Brothers & Co., 38 Park Row, New York.
Volney W. Mason & Co., Providence, R. I.

Emery Mill Stones.

Sturtevant Mill Co., Boston Mass.

Emery Wheels.

J. Wendell Cole, Box 84, Columbus, O.
Springfield Emery Wheel Mfg.Co.,Bridgeport,Conn.

Emery Wheel Machinery.

Springfield Emery Wheel Mfg.Co.,Bridgeport, Conn.

Engineering Instruments.

A. S. Aloe & Co., St. Louis, Mo.
Theo. Alteneder & Sons. Brooklyn, N. Y.
Brandis Sons Co., Philadelphia, Pa.
Charles H. Brightly, Philadelphia, Pa.
Keuffel & Esser Co., 127 Fulton St., N. Y.
Queen & Co. Philadelphia, Pa.

Engines, Blowing.

Edw. P. Allis Co., Milwaukee, Wis.
Southwark Foundry and Machine Co., Phila., Pa.
Walker Manufacturing Co., Cleveland, Ohio.

Engines, Gas, Gasoline, and Petroleum.

Otto Gas Engine Works, Philadelphia, Pa.

Engines, Marine.

Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Shipman Engine Co., Boston, Mass.

Engines, Portable.

Griffith & Wedge Co., Zanesville, Ohio.
Porter Mfg. Co., Syracuse, N. Y.

Engines, Stationary.

Edw. P. Allis Co., Milwaukee, Wis.
Beckett Foundry and Machine Co., Arlington, N. J.
Buckeye Engine Co., Salem, Ohio.
M. C. Bullock Mfg. Co., Chicago, Ill.
Campbell & Zell Co., Baltimore, Md.
Cooke & Co., 163 Washington St., N. Y.
Fishkill Landing Machine Co , Fishkill, N. Y.
Fraser & Chalmers, Chicago, Ill.
Frick Company, Waynesboro, Pa.
Hooven, Owens & Rentschler, Co., Hamilton, Ohio.
Howard & Morse, 45 Fulton St., N. Y.
Lane & Bodley Co., Cincinnati, Ohio.
Oil Well Supply Co., Pittsburgh, Pa.
Robert Poole & Son Co., Baltimore, Md.
Porter Mfg. Co. Limited, Syracuse, N. Y.
Shipman Engine Co., Boston, Mass.
Southwark Foundry and Machine Co., Phila., Pa.
Stearns Manufacturing Co., Erie, Pa.
Webster, Camp & Lane Machine Co., Akron, O.
Robert Wetherill & Co., Chester, Penn.
Whitman & Barnes Mfg. Co., Syracuse, N. Y.

Excavators.

Bucyrus Steam Shovel and Dredge Co., Bucyrus, O.
Jeffrey Mfg. Co., Columbus, Ohio.
Marion Steam Shovel Co., Marion, Ohio.
Osgood Dredge Co., Albany, N. Y.
John Souther & Co., Boston, Mass.

Fans, Ventilating.

M. C. Bullock Mfg. Co., Chicago, Ill.
Howard & Morse, 45 Fulton Street, N. Y.

Feed-Water Heaters.

Wm. Baragwanath & Son, Chicago.
Edw. P. Allis Co., Milwaukee, Wis.
Campbell & Zell Co., Baltimore, Md.
National Pipe Bending Co., New Haven, Conn.
Robt. Wetherill & Co., Chester, Pa.

Fertilizer Machinery.

Jeffrey Mfg. Co., Columbus, Ohio.
Robert Poole & Son Co., Baltimore, Md.

Filters.

Albany Steam Trap Co., Albany, N. Y.
Bradley & Company, Syracuse, N. Y.
Cumberland Mfg. Co., Boston, Mass.
R. D. Wood & Co., Philadelphia, Pa.

Fire Arms.

Smith & Wesson, Springfield, Mass.
J. Stevens Arms & Tool Co., Chicopee Falls, Mass.

Fireproof Building Material.

Lorillard Brick Works Co., 92 Liberty St., N. Y.
Pennsylvania Steel Co., Steelton, Pa.
Pioneer Fireproof Construction Co., Chicago, Ill.
Raritan Hollow and Porous Brick Co., 874 Broadway, N. Y.
Wm. B. Scaife & Sons, Pittsburg, Pa.

Flouring Mill Machinery.

Edw. P. Allis Co., Milwaukee, Wis.
Dayton Globe Iron Works Co., Dayton, Ohio.

Fly Wheels.

Edw. P. Allis Co., Milwaukee, Wis.
Geo. V. Cresson, Philadelphia, Pa.
Robert Poole & Son Co., Baltimore, Md.
Walker Manufacturing Co., Cleveland, Ohio.

Forges.

B. F. Sturtevant Co., Boston, Mass.
Cooke & Co., 163 Washington St., N. Y.

Forgings.

Audubon Machine Works, New Haven, Conn.
Billings & Spencer Co., Hartford, Conn.
Crescent Steel Co., Pittsburgh, Pa.

Furnace Builders.

Griffith & Wedge Co., Zanesville, Ohio.
Julian Kennedy, Pittsburgh, Pa.

Furniture and Chair Machinery.

The Egan Co., Cincinnati, Ohio.
J. A. Fay & Co., Cincinnati, Ohio.
John A. White Co., Dover, N. H.

Gas Machines.

Detroit Heating and Lighting Co., Detroit, Mich.

Gas Works Machinery.

R. D. Wood & Co., Philadelphia, Pa.
Continental Iron Works, Brooklyn, N. Y.

Gate Valves.

Albany Steam Trap Co., Albany, N. Y.
R. D. Wood & Co., Philadelphia, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Continental Iron Works, Brooklyn, N. Y.
Jenkins Brothers, 71 John St., N. Y.
Lunkenheimer Brass Mfg. Co., Cincinnati, Ohio.

Gauges, Steam.

Bristol's Mfg. Co., Waterbury, Conn.
Crosby Steam Gage and Valve Co., Boston, Mass.
Standard Thermometer Co., Peabody, Mass.

Gear Cutters.

Brown & Sharpe Mfg. Co., Providence, R. I.
E. Horton's Sons Co., Windsor Locks, Conn.
Walker Manufacturing Co., Cleveland, Ohio.

Gearing.

Edw. P. Allis Co., Milwaukee, Wis.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dayton Globe Iron Works Co., Dayton, Ohio.
Geo. V. Cresson, Philadelphia, Pa.
Griffith & Wedge Co., Zanesville, Ohio.
R. D. Wood & Co., Philadelphia, Pa.
Robert Poole & Son Co., Baltimore, Md.
Walker Manufacturing Co., Cleveland, Ohio.

Girders.

Pennsylvania Steel Co., Steelton, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.
Wrought Iron Bridge Co., Canton, Ohio.

Grain Elevator Machinery.

Edw. P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, Ohio.
Link Belt Engineering Co., Phila., Pa.
Robert Poole & Son Co., Baltimore, Md.
Walker Manufacturing Co., Cleveland, Ohio.

Grinding and Polishing Machinery.

Brown & Sharpe Mfg. Co., Providence, R. I.
J. Wendell Cole, Box 84, Columbus, O.
Diamond Machine Co., Providence, R. I.
Morse Twist Drill & Machine Co., New Bedford Mass.

Grips, Cable Railways.

Robert Poole & Son Co., Baltimore, Md.
Walker Manufacturing Co., Cleveland, Ohio.
Robt. Wetherill & Co., Chester, Pa.

Hammers, Power.

E. W. Bliss Co., Ltd., Brooklyn, N. Y.

Hangers.

SEE PULLEYS, ETC.

Hardware Manufacturers.

Stanley Rule and Level Co., New Britain, Conn.
J. Stevens Arms & Tool Co., Chicopee Falls, Mass.
Volney W. Mason & Co., Providence, R. I.
Yale & Towne Mfg. Co., Stamford, Conn.

Heating and Ventilating Apparatus.

B. F. Sturtevant Co., Boston, Mass.
Cooke & Co., 163 Washington St., N. Y.

Heaters, Steam and Hot Water.

Capitol Heater Co., Detroit, Mich.
Boynton Furnace Co., 207 Water St., New York.
Broomell, Schmidt & Co., Ltd., York, Pa.
Consolidated Car-Heating Co., Albany, N. Y.
Detroit Heating and Lighting Co., Detroit, Mich.
Eureka Steam Heating Co., Rochester, N. Y.
Gorton & Lidgerwood Co., 96 Liberty St., N. Y.
Gurney Hot Water Heater Co., Boston Mass.
W. C. Mowry, Norwich, Conn.
National Hot Water Heater Co., Boston, Mass.
J. F. Pease Furnace Co., Syracuse, N. Y.
Pierce Butler & Pierce Mfg. Co., Syracuse, N. Y.
Russel Wheeler & Son, Utica, N. Y.
H. B. Smith Co., 137 Center St., N. Y.

Hoisting Engines and Machinery.

Edw. P. Allis Co., Milwaukee, Wis.
Beckett Foundry and Machine Co., Arlington, N. J.
Boston & Lockport Block Co., Boston, Mass.
Brown Hoisting and Conveying Co., Cleveland, Ohio.
M. C. Bullock Mfg. Co., Chicago, Ill.
Cooper, Hewitt & Co., 17 Burling Slip, N. Y.
Copeland & Bacon, 85 Liberty St., N. Y.
Griffith & Wedge Co., Zanesville, Ohio.
C. W. Hunt Co., 45 Broadway, N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Volney W. Mason & Co., Providence, R. I.
H. J. McKeown, Cincinnati, O.
J. S. Mundy, Newark, N. J.
Webster, Camp & Lane Machine Co., Akron, O
R. D. Wood & Co., Philadelphia, Pa.
Sullivan Machiners Co., Chicago, Ill.
Trenton Iron Co., Trenton, N. J.
Walker Manufacturing Co., Cleveland, Ohio.
Yale & Towne Mfg. Co., Stamford, Conn.

Hollow Bricks.

Lorillard Brick Works Co., 92 Liberty St., N. Y.
Pioneer Fireproof Construction Co., Chicago, Ill.
Raritan Hollow and Porous Brick Co., 874 Broadway, N. Y.

Hose, Steam and Fire.

Crosby Steam Gage and Valve Co., Boston, Mass.
B. F. Goodrich Co., Akron, Ohio.
Home Rubber Co., Trenton, N. J.

Ice-Making Machinery.

Frick Compauy, Waynesboro, Pa.

Indicators, Steam-Engine.

Crosby Steam Gage and Valve Co., Boston, Mass.

Injectors.

Penberthy Injector Co., Detroit, Mich.

Industrial Railways.

C. W. Hunt Co., 45 Broadway, N. Y.

Insulated Wire.

Merchant & Co., Philadelphia, Pa.
New York Insulated Wire Co., 649-651 B'dway, N. Y.
The Okonite Co,, Limited, 13 Park Row, N. Y.

Iron Working Machinery.

W. F. & J. Barnes Co., Rockford, Ill.
Billings & Spencer Co., Hartford, Conn.
E. W. Bliss Co., Limited, Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
E. Horton's Sons Co., Windsor Locks, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Lodge & Davis Machine Tool Co., Cincinnati, Ohio.
Long & Allstatter Co., Hamilton, Ohio.
Niles Tool Works, Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Walker Manufacturing Co., Cleveland, Ohio.

Joists, Iron and Steel.

Campbell & Zell Co., Baltimore, Md.
Wm. B. Scaife & Sons, Pittsburg, Pa.

Lathes.

W. F. & J. Barnes Co., Rockford, Ill.
Bridgeport Machine Tool Works, Bridgeport, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Lodge & Davis Machine Tool Co., Cincinnati, Ohio.
Niles Tool Works, Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Sebastian Lathe Co., Cincinnati, Ohio.

Lamps.

Pittsburgh Brass Co., Pittsburgh, Pa.

Lighting Apparatus.

Detroit Heating and Lighting Co., Detroit, Mich.

Locomotive Brakes.

New York Air Brake Co., 115 Broadway, N. Y.
Westinghouse Air Brake Co., Pittsburgh, Pa.

Lubricants.

Jos. Dixon Crucible Co., Jersey City, N. J.

Lubricators.

Lunkenheimer Brass Mfg. Co., Cincinnati, Ohio.

Machine Tools.

W. F. & J. Barnes Co., Rockford, Ill.
Billings & Spencer Co., Hartford, Conn.
Bridgeport Machine Tool Works, Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cooke & Co., 163 Washington St., N. Y.
The E. Horton & Son Co., Windsor Locks, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Lodge & Davis Machine Tool Co., Cincinnati, Ohio.
Long & Allstatter Co., Hamilton, Ohio.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Machinery Co., Tiffin, Ohio.
Niles Tool Works, Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Walker Manufacturing Co., Cleveland, Ohio.
John A. White Co., Dover, N. H.

Machinery, Special.

Audubon Machine Works, New Haven, Conn.
Billings & Spencer Co., Hartford, Conn.
E. W. Bliss Co., Limited, Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
J. A. Fay & Co., Cincinnati, Ohio.
E. Horton & Son Co., Windsor Locks, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
National Machinery Co., Tiffin, Ohio.
R. D. Wood & Co., Philadelphia, Pa.
Robert Poole & Son Co., Baltimore, Md.
John A. White Co., Dover, N. H.
Pratt & Whitney Co., Hartford, Conn.
Walker Manufacturing Co., Cleveland, Ohio.
Wheeler Condenser & Eng. Co., 92 Liberty St., N. Y.

Machinists' Tools and Supplies.

W. F. & J. Barnes Co., Rockford, Ill.
Billings & Spencer Co., Hartford, Conn.
Bridgeport Machine Tool Works, Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cooke & Co., 163 Washington St., N. Y.
J. Wendell Cole, Box 84, Columbus, O.
The E. Horton & Son Co., Windsor Locks, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Lodge & Davis Machine Tool Co., Cincinnati, Ohio.
Long & Allstatter Co., Hamilton, Ohio.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Niles Tool Works, Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Sebastian Lathe Co., Cincinnati, Ohio.
J. Stevens Arms & Tool Co., Chicopee Falls, Mass.

Mathematical Instruments.

A. S. Aloe & Co., St. Louis, Mo.
Theo. Alteneder & Sons, Philadelphia, Pa.
Charles H. Brightly, Philadelphia, Pa.
Keuffel & Esser Co., 127 Fulton St., N. Y.
Queen & Co., Philadelphia, Pa.

Merchant Steel.

Chester Steel Castings Co., Phila., Pa.
Crescent Steel Co., Pittsburgh, Pa.
Wm. Jessop & Sons, Limited, 91 John St., N. Y.

Metal Separator.

Ezra Sawyer, Worcester Mass.

Meters, Water.

Deane Steam Pump Co., Holyoke, Mass.
Henry R. Worthington, 86-88 Liberty St., N. Y.

Mill Stones.

Sturtevant Mill Co., Boston, Mass.

Millwrights.

Geo. V. Cresson, Philadelphia, Pa.
H. J. McKeon, Cincinnati, Ohio.

Mining Screens.

Beckett Foundry and Machine Co., Arlington, N. J.
Copeland & Bacon, 85 Liberty St., N. Y.
Harrington & King Perf. Co., Chicago, Ill.
Howard & Morse, 45 Fulton St., N. Y.
Fraser & Chalmers, Chicago, Ill.
Jeffrey Mfg. Co., Columbus, Ohio.

Mining Machinery.

Beckett Foundry and Machine Co., Arlington N. J.
M. C. Bullock Mfg. Co., Chicago, Ill.
Chrome Steel Works, Brooklyn, N. Y.
A. S. Cameron Steam Pump Works, E. 23d St., N. Y.
Copeland & Bacon, 85 Liberty St., N. Y.
Fraser & Chalmers, Chicago, Ill.
Frisbee-Lucop Mill Co., 145 Broadway, N. Y.
Gates Iron Works, Chicago, Ill.
Griffith & Wedge Co , Zanesville, Ohio.
Harrington & King Perf. Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., 10 Park Pl., N. Y.
Jeffery Mfg. Co , Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
J. S. Mundy, Newark, N. J.
Niagara Steam Pump Works, 34 Dey , N. Y.
Robert Poole & Son Co., Baltimore, M
Smith & Vaile Co., Dayton, Ohio.
Sturtevant Mill Co., Boston, Mass.
Sullivan Machinery Co., Chicago, Ill.
Trenton Iron Co., Trenton, N. J.
Webster, Camp & Lane Machine Co., Akron, O.

Motors, Electric.

Audubon Machine Works, New Haven, Conn.
Belknap Motor Co., Portland, Me.
Brownell Car Co., St. Louis, Mo.
The Crocker-Wheeler Co., 430-432 W. 14th St., N. Y.
Eddy Electric Mfg. Co., Windsor, Conn.
Jeffrey Mfg. Co., Columbus, Ohio.
Standard Thermometer Co., Peabody, Mass.

Motors, Water.

Belknap Motor Co., Portland, Me.

Henry R. Worthington, 86-88 Liberty St., N. Y.
R. D. Wood & Co., Philadelphia, Pa.

Oil Cups, Glass.

Lunkenheimer Brass Mfg. Co., Cincinnati, Ohio.

Ornaments, Stamped Sheet Metal.

Kinnear & Gager Co., Columbus, Ohio.
W. H. Mullins, Salem, Ohio.

Packing.

The B. F. Goodrich Co., Akron, Ohio.
Home Rubber Co., Trenton, N. J.
Garlock Packing Co., Palmyra, N. Y.
Jenkins Bros., 71 John St. N. Y.

Paints.

Joseph Dixon Crucible Co., Jersey City, N.J.
Harrison Bros. & Co., Philadelphia, Pa.

Paper Mill Machinery.

Dayton Globe Iron Works, Dayton, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Moore & White Co., Philadelphia, Pa.
Robert Poole & Son Co., Baltimore, Md.
Walker Manufacturing Co., Cleveland, Ohio.
Robt. Wetherill & Co., Chester, Pa.

Patent Attorneys.

Munn & Co., 361 Broadway, N. Y.
H. F. Parker, 35 Wall St., New York.
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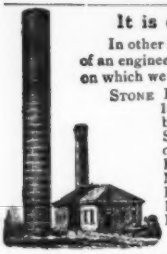

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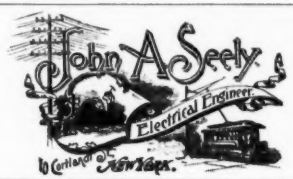

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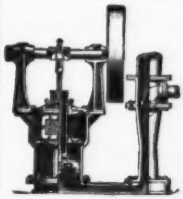

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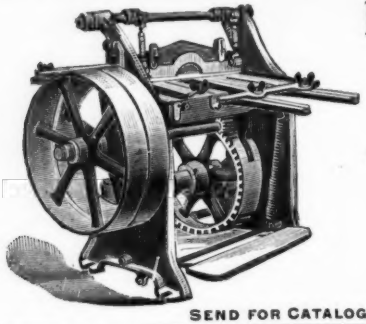

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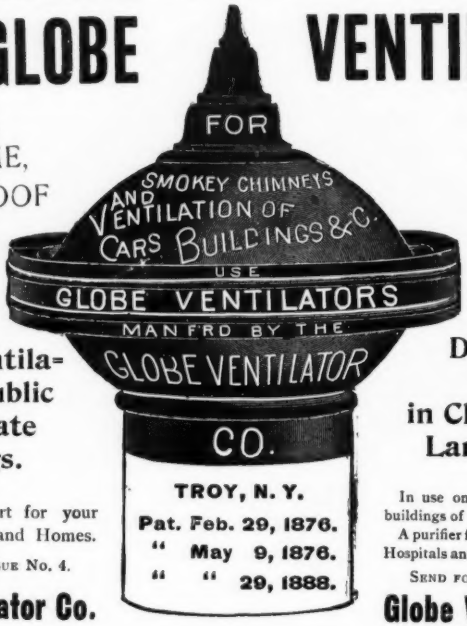

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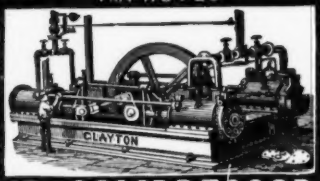

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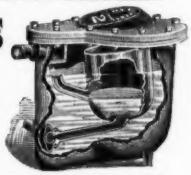

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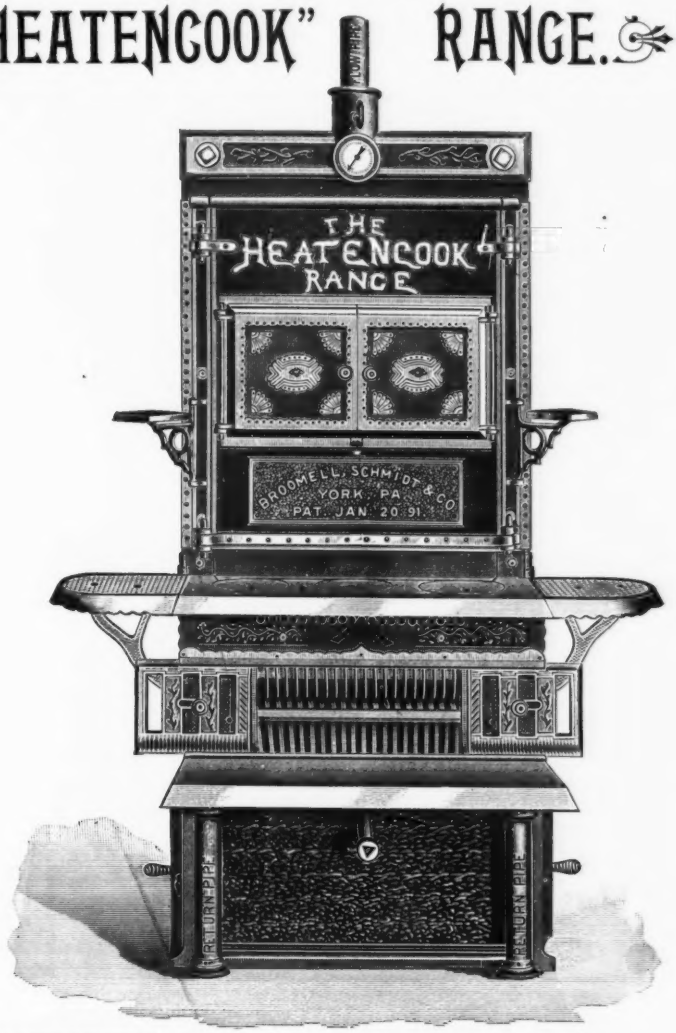

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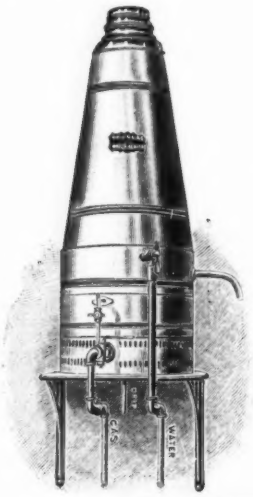

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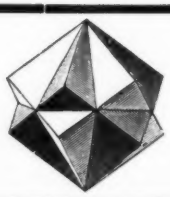
TRADE  MARK.

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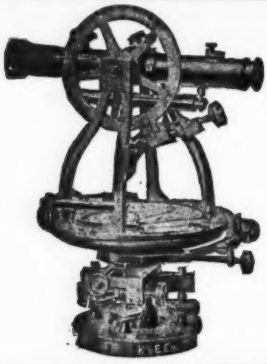

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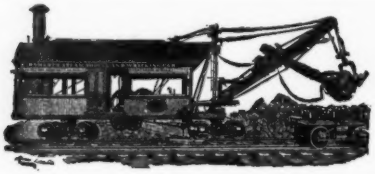

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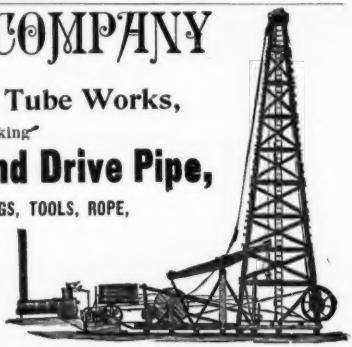

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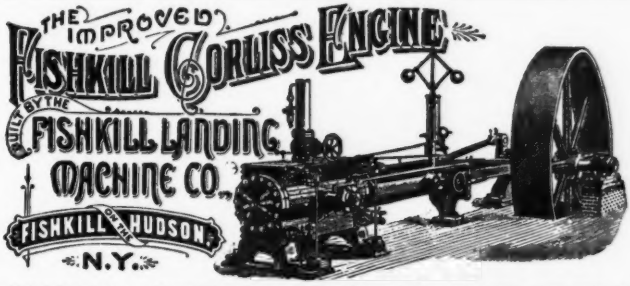

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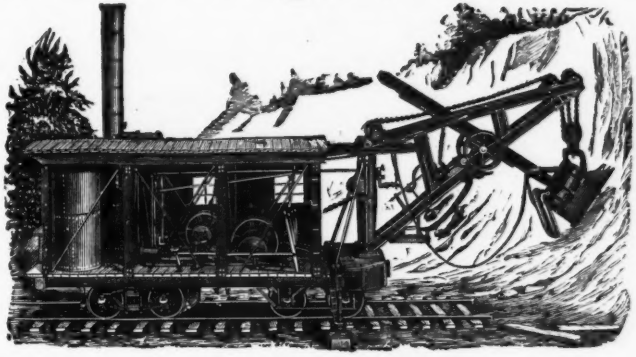

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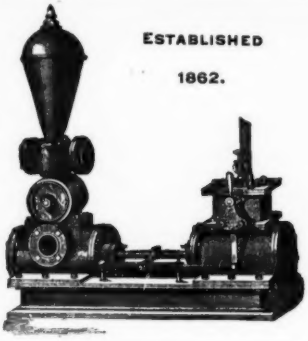

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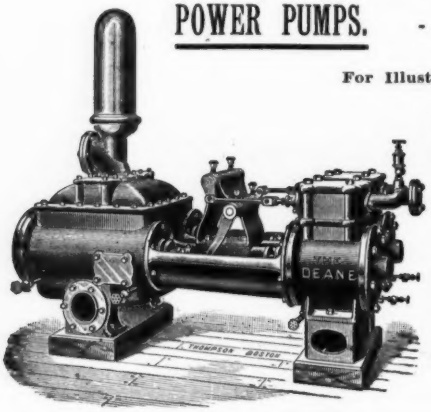

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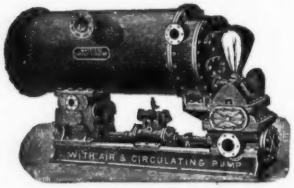

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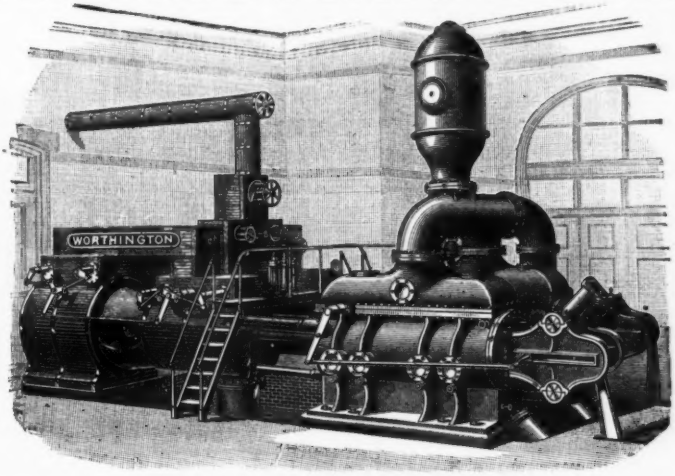

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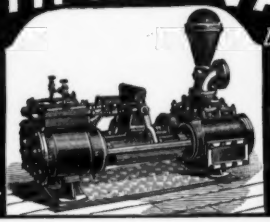

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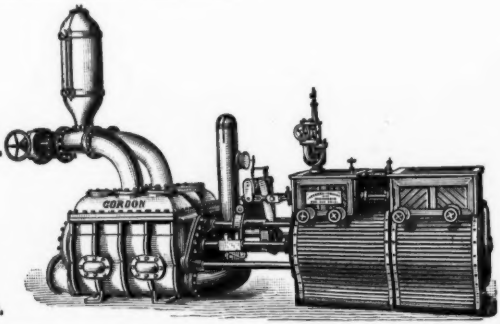

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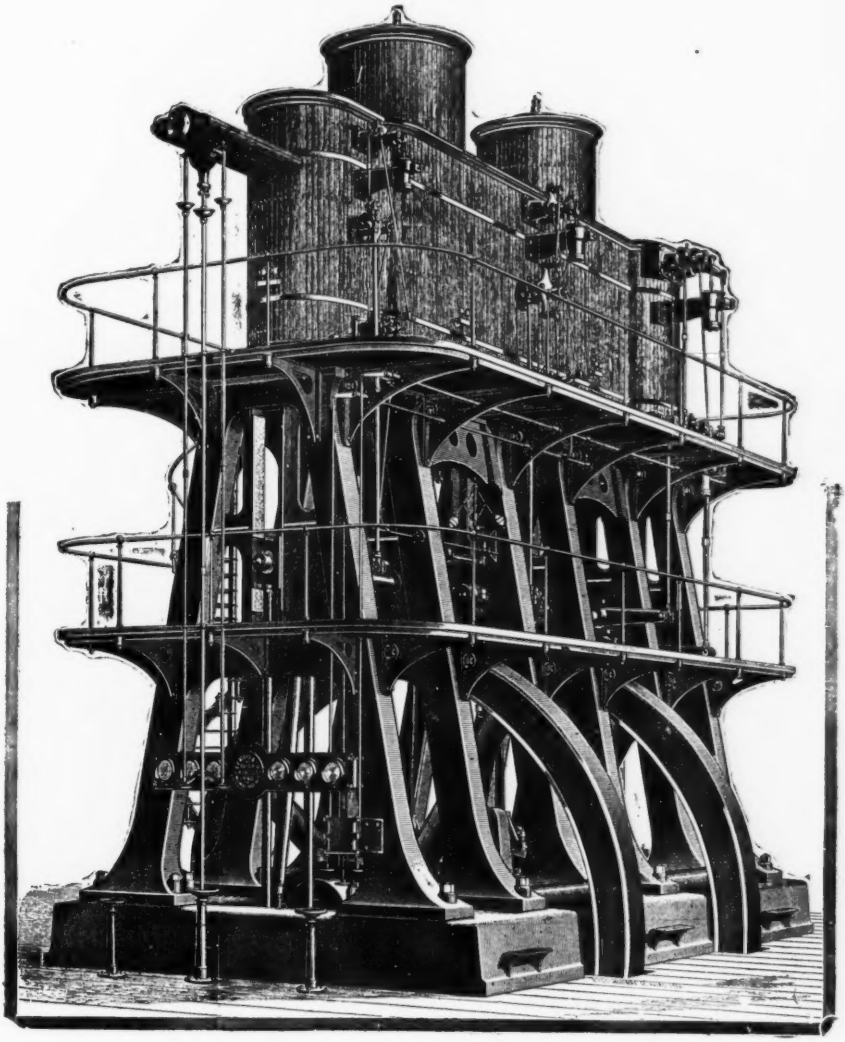

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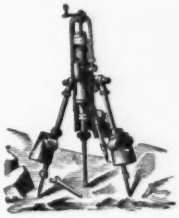

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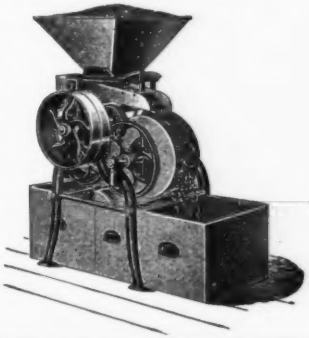

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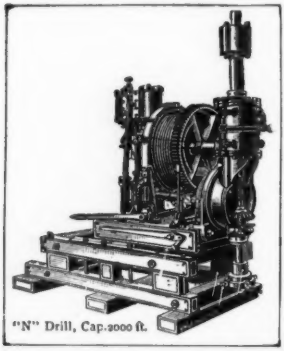

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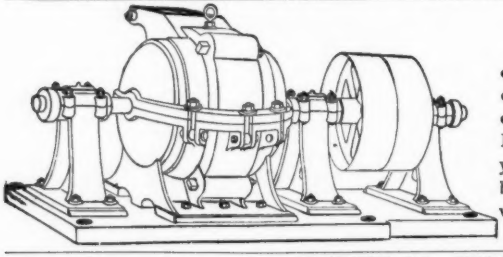

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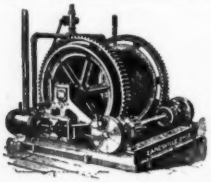

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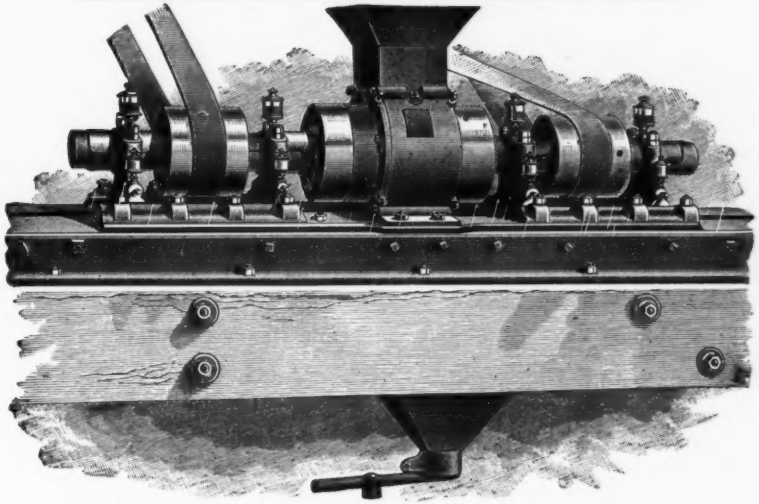

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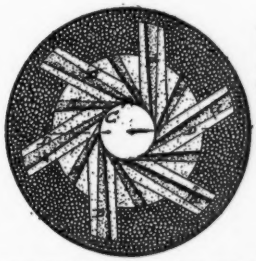
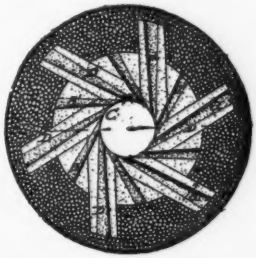


Rock Emery Mill Stones.



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Require little Dressing, and much more Durable. **Will fit any Burr-Mill Frame.**

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CAST IRON HUB OR FLANGE PIPE,

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very valve tested and warranted, all parts interchangeable.
othing but best Steam Metal used in the manufacture.
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A BRASS COIL HEATER
Delivering Water to the Boilers at 212° Fahrenheit.

500,000 HORSE POWER NOW IN USE.

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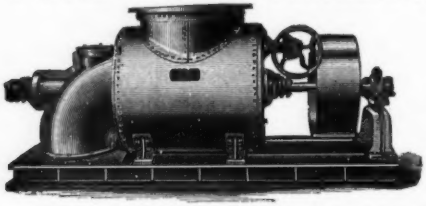

High efficiency at all stages of gate; steadiness of motion and easy working gate.

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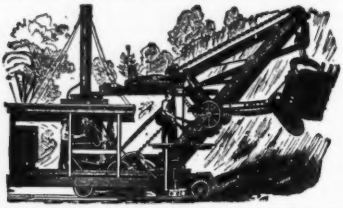

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I hereby certify that I have used the Otis patent improved Steam Excavators the past twenty years, in all kinds of earth excavations, and believe it to be the best dry land excavator in use, and the only one that will work successfully in hard pan material. I have excavated and put into cars five million yards under one contract for making land in Boston; with two of these machines I loaded from seventy to eighty thousand yards per month.

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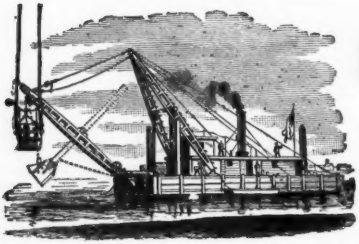

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THE CURTIS PIPE THREADING ATTACHMENT FOR LATHES.

No. 3½. Power Pipe Cutting and Threading Machine
RANGE 2¼-6".

Ratchet Drills
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Renders the most Turbid or Roily Water
CLEAR and COLORLESS.
Particularly adapted to the large requirements of
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OPERATES BY GRAVITY. NO PRESSURE USED.

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THE BUNNELL FEED-WATER FILTER.

"CLEAN AS A WHISTLE."

The Bunnell Feed-Water Filter and Process will positively furnish steam boilers with feed water that is absolutely free from scale and mud-producing substances, and thus literally keep boilers "clean as a whistle."

We are prepared to contract for the erection of our apparatus under the strongest and longest guarantee ever given. Circulars upon application and correspondence solicited.

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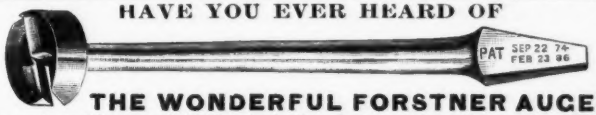

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If not, it will pay you to send for a sample 4/8 bit and price-list. Sent on receipt of 55 cents. It will bore Round, Oval and Square Holes, and cannot be equaled for fine carpentry, cabinet or pattern work. Discount to dealers on application.

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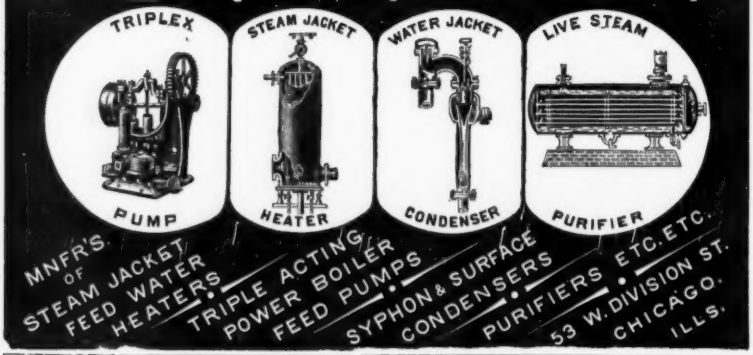

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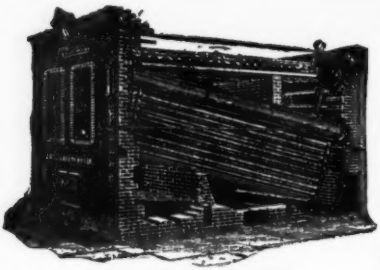

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SAFETY, ECONOMY AND DURABILITY.

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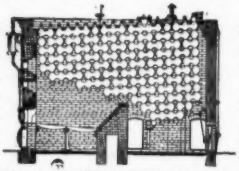

Established in 1863, these boilers have been thoroughly tested and their merits proven by over twenty-five years practical work.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H. P. to the largest batteries.

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THE

SONG OF THE PULSOMETER.

By CAPT. JACK CRAWFORD,
"THE POET SCOUT."

The "Pul-so-ME-ter" Pump.

[AS TOLD BY A FAR WEST RANCHMAN BEFORE THE RECENT IRRIGATION CONVENTION IN NEW MEXICO, IN FAVOR OF PUMPS VS. LONG MUDDY DITCHES.]

Copyrighted 1892, by Pulsometer Steam Pump Co.

I seed a gapin' crowd one day,
A standin' by the Rio Grande,
An' gazin' in a earnest way
At somethin' restin' on the sand,
An' think says I some feller's caught
A fish o' more than common size,
An', bankin' on that na'chul thought,
I went to hear the usual lies.

I seed Big Frank an' Curly Bill,
An' rancher Moore from Soledad,
An' Greaser Pete, an' Broncho Phil,
An' ol' Mike Bilson's stepboy Thad,
An' w'en them fellers amble out
To buck agin each other's lies,
The way they chaw their cuds an' spout
'D make you water at the eyes.

But w'en I elbowed through the ring,
I found it wa'nt no fish at all,
But jes' a funny lookin' thing
A standin' thar' 'bout three feet tall.
'Twas taper-necked, an' somethin' like
Two bottles clus together stuck;
I ses, ses I, to Denver Ike:
"W'at ar' the racket you have struck?"

Then Ike he give his pants a hitch,
An' sed: "By lookin' over thar'
You'll see a irrigatin' ditch
J'ined by a pipe to this thing 'yar.
A six-inch pipe perambulates
Atween the two along the sand;
That other pipe that this 'un mates,
Ar' stuck into the Rio Grande.

"This little narrer iron pipe
Runs to that b'iler, an' the man
Ses soon as steam ar' good an' ripe,
Hell's fat 'll pop out o' the pan.
He says he'll bet the funny thing
Agin a ragged woolen shirt,
That w'en it strikes the proper swing,
'Twill beat a cloudburst on the squirt."

Fust thing we knowed we heerd a hiss,
An' then some sort o' little clicks,
As regular, and soundin' jes'
As Andy Martin's big clock ticks,
An' right into the ditch, I swar',
That cussed little baby pump,
Jes' made us think the river war'
A comin' that way on the jump.

Us fellers whooped an' yelled an' cheered,
An' doubtful onbelievers caved,
An' in the jamboree I heerd
Jedge Baldwin say, "The country's saved.
These desert lands we allus thought
Not wuth the wind that o'er 'em blows,
Will be a heavenly garden spot,
An' made to blossom as the rose!

"The only trouble in the past
Has been to find a perfect way
To irrigate 'em an' at last
We see the dawnin' o' the day!"
Jedge Baldwin's speeches allus teemed
With lofty words, but w'at he said
About the patent squirter seemed
To biff the nail right on the head.

Me an' my wife had fixed a scheme
To pack an' emigrate back east,
Because this country didn't seem
A proper place for man or beast,
But w'en I seed that clicker play
I sought my "rancho" on the jump,
An' shouted: "Jane, right 'yar we stay
An' git a pul-so-*me*-ter pump!"

I got one jes' two years ago,
As others did, an' now it seems
That luck 'll never cease to flow
In rousin' pul-so-*me*-ter streams.
I've paid the hangin' debts o' years,
My credit at the bank is sound,
An' Jane she says the thing appears
To squirt true happiness all 'round.

CAPT. JACK CRAWFORD, "The Poet Scout."]

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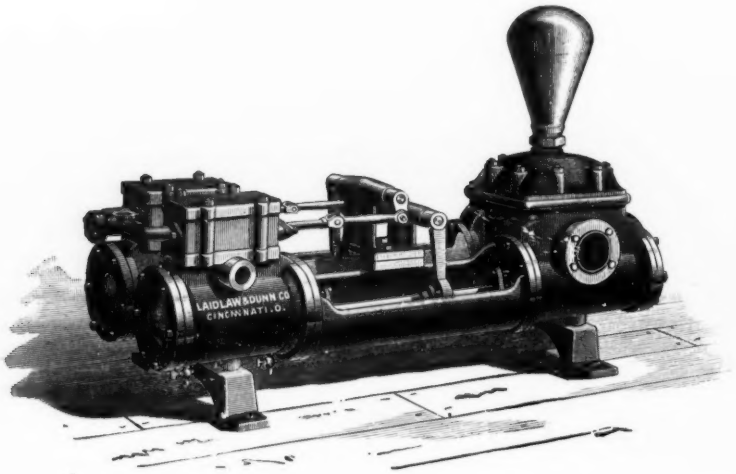
STEAM PUMPS

OF EVERY SERVICE.



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Petroleum and Kerosene Oil FUEL.

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8 and 22 Horse Power, Compound.

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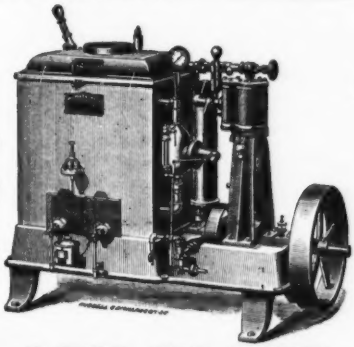

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The most economical, reliable and satisfactory power on the market for Printers, Farmers, Wheelwrights, Blacksmiths, for Creameries, for Elevating Water and small manufacturers.

SHIPMAN ENGINE CO.,

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COOK'S SYSTEM OF TUBE WELLS.

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No. 109 East Chemung Place, Elmira, N. Y.

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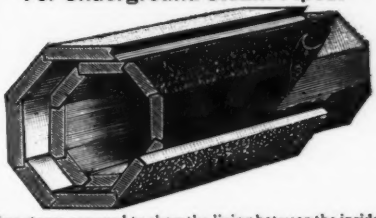
PATENT STEAM PIPE CASING

For Underground Steam Pipes.



Two staves removed to show the lining between the inside and outside staves of our Patent Steam Pipe Casing.

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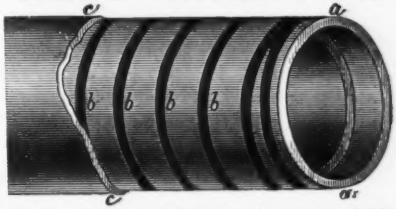

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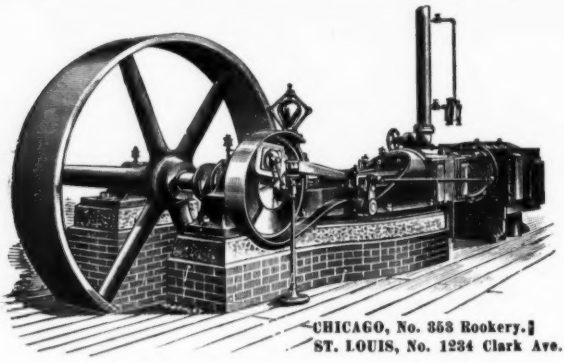

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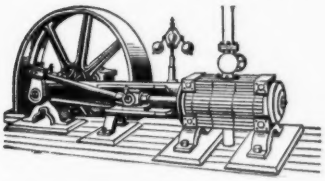

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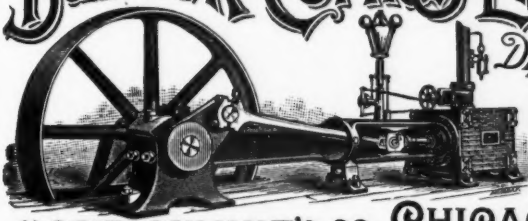

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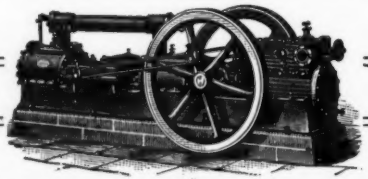

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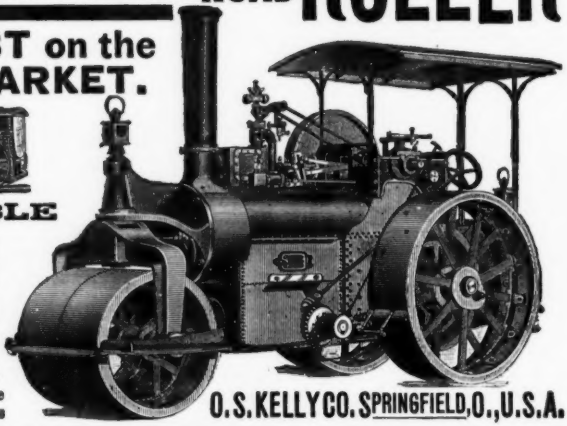

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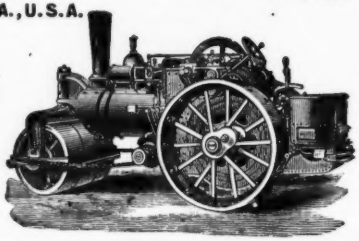

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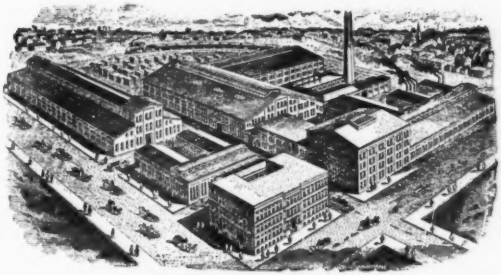

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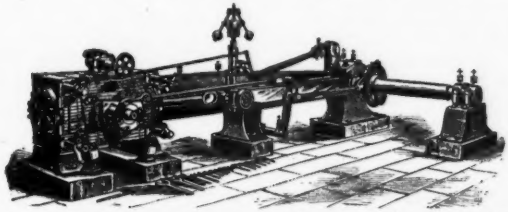

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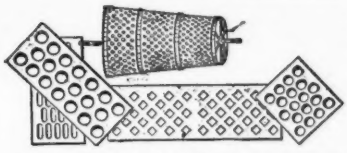

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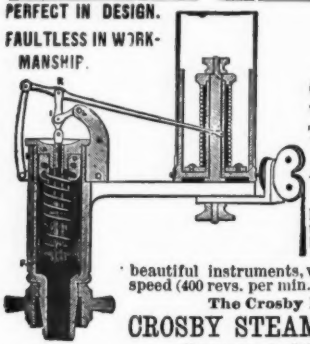

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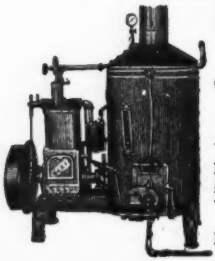

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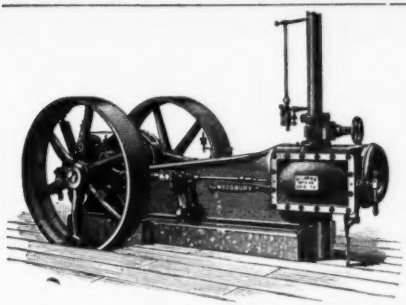

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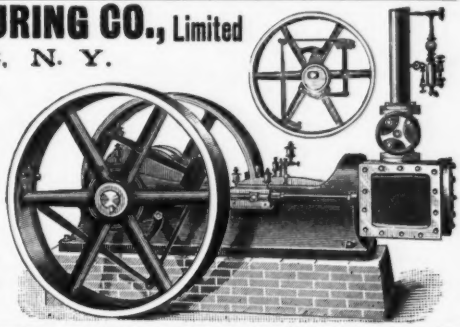

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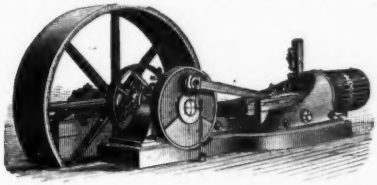

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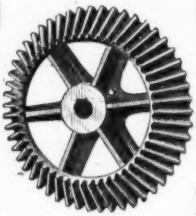

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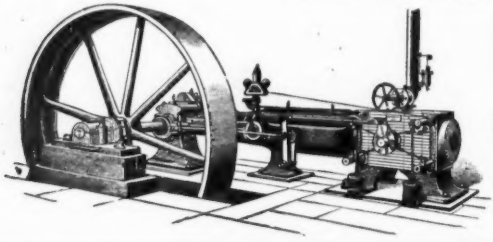

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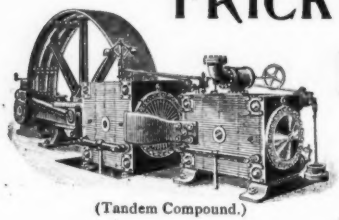

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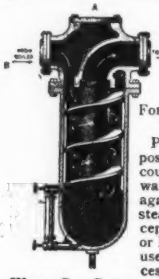

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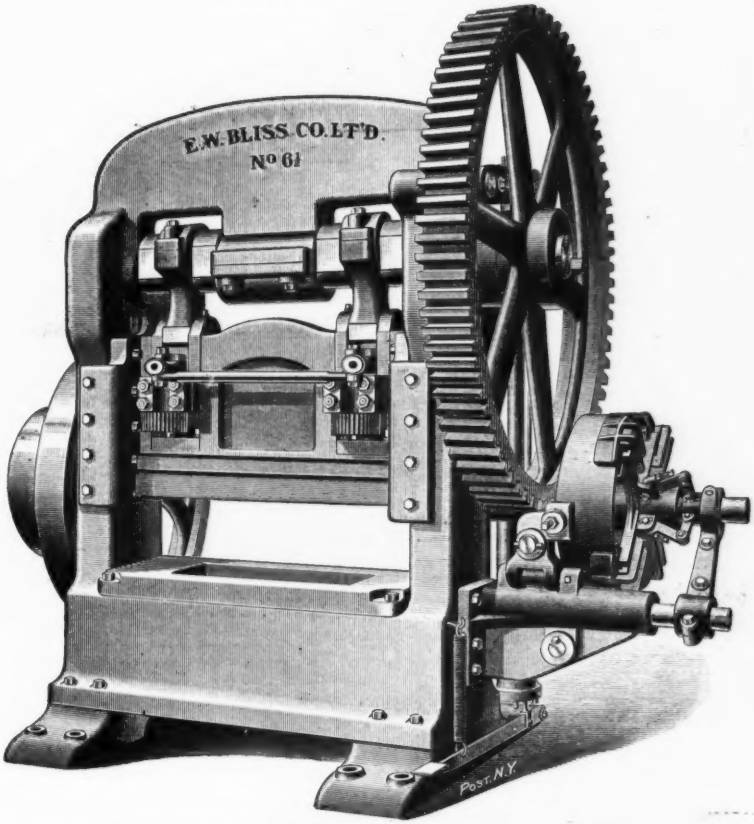

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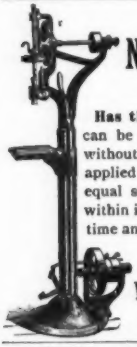

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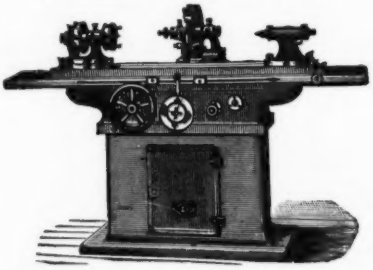

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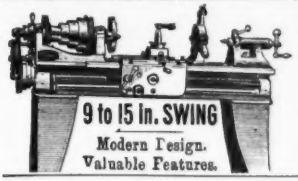

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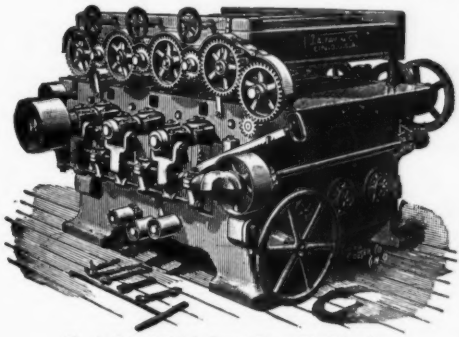

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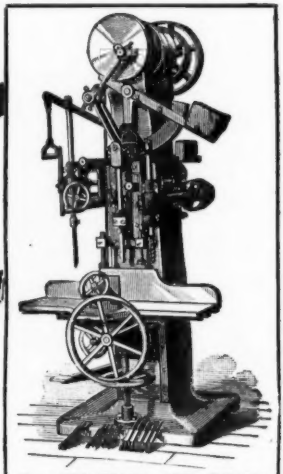

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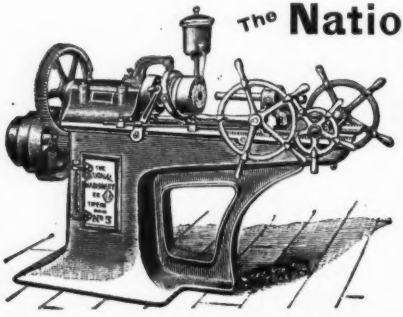

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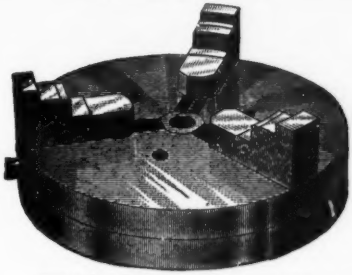

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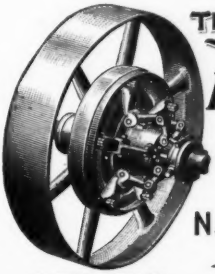

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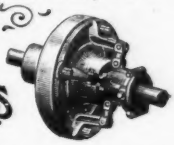

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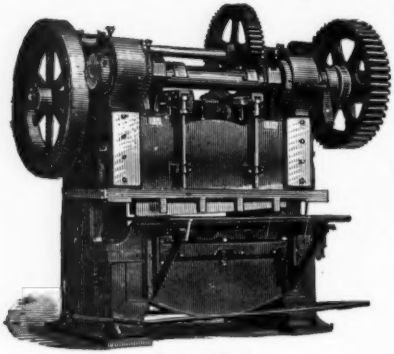

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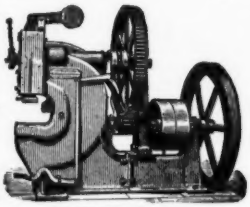

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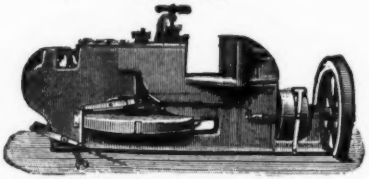

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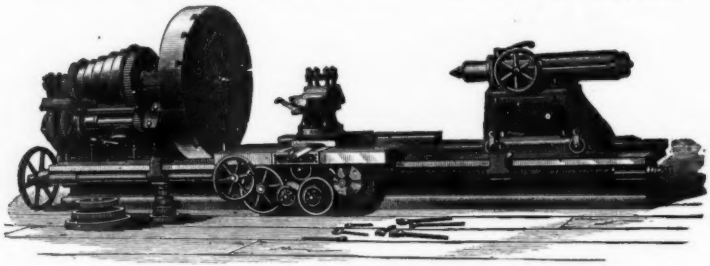

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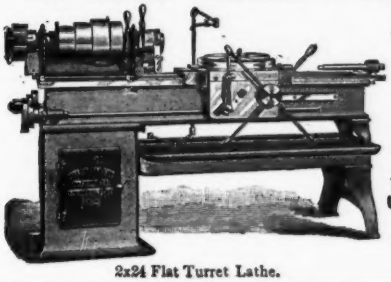

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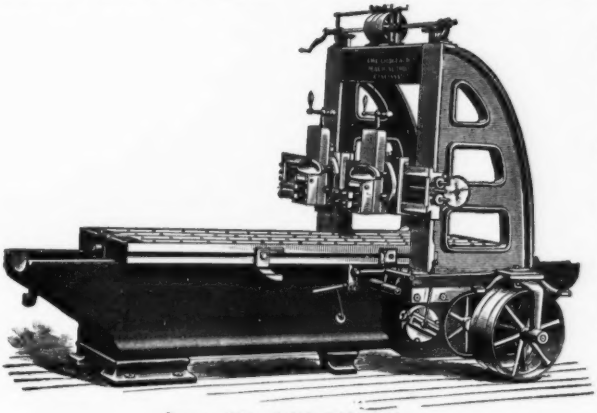

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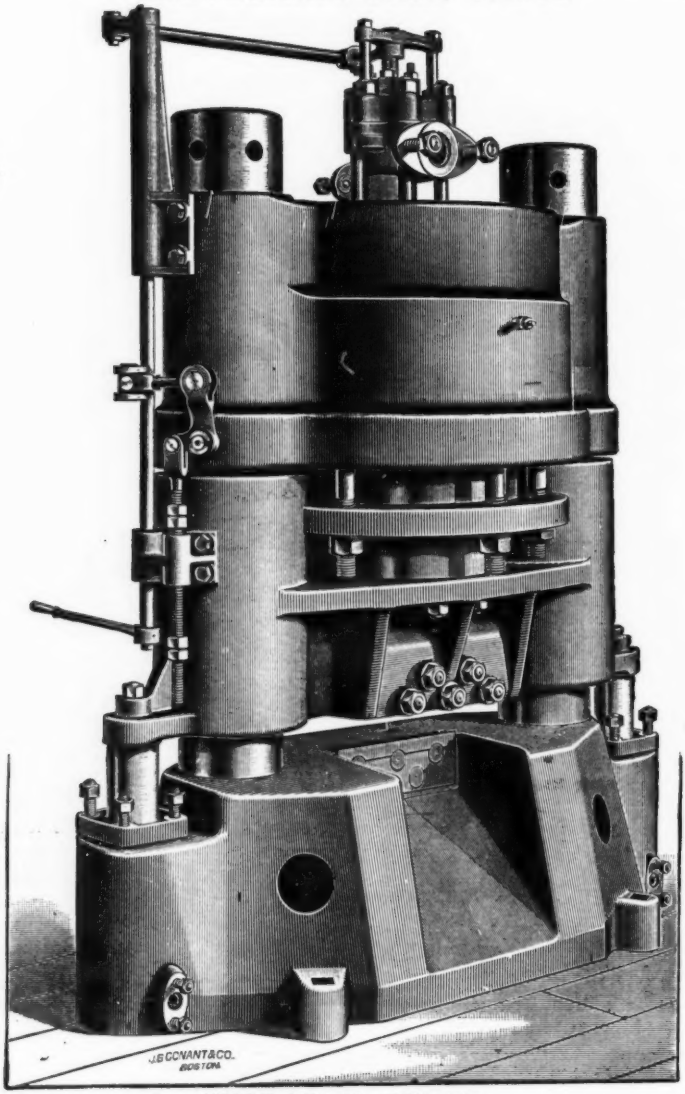

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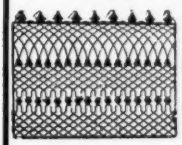

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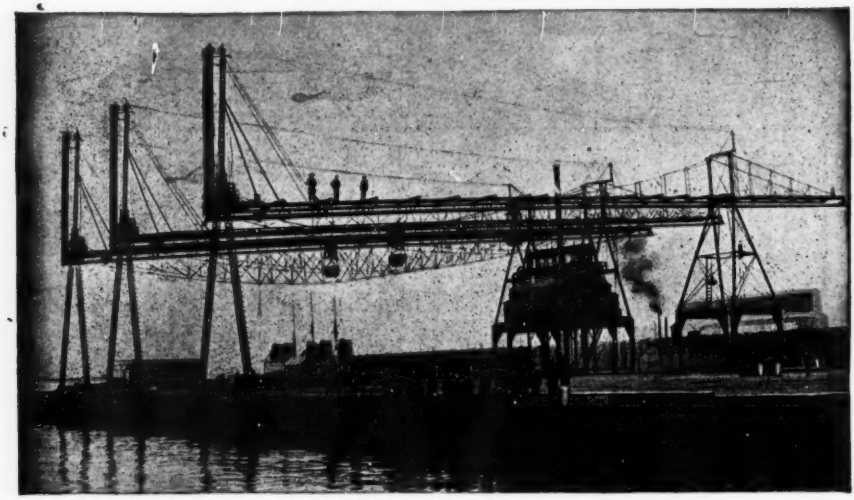

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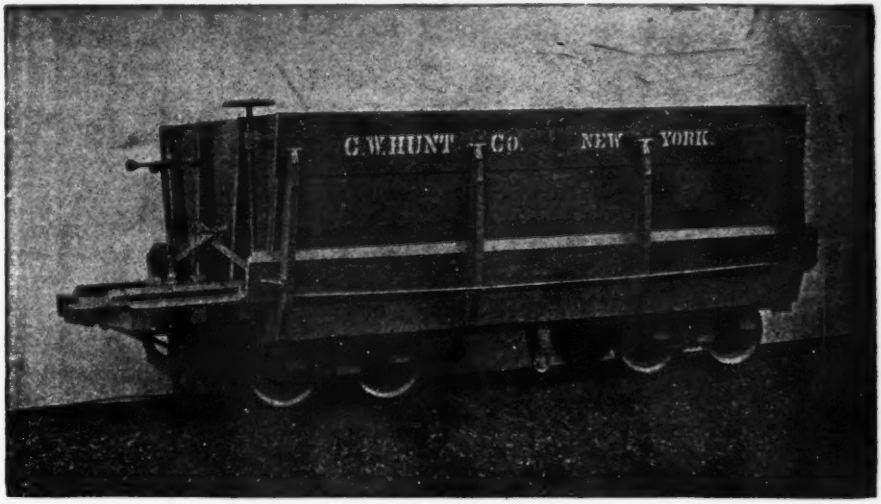

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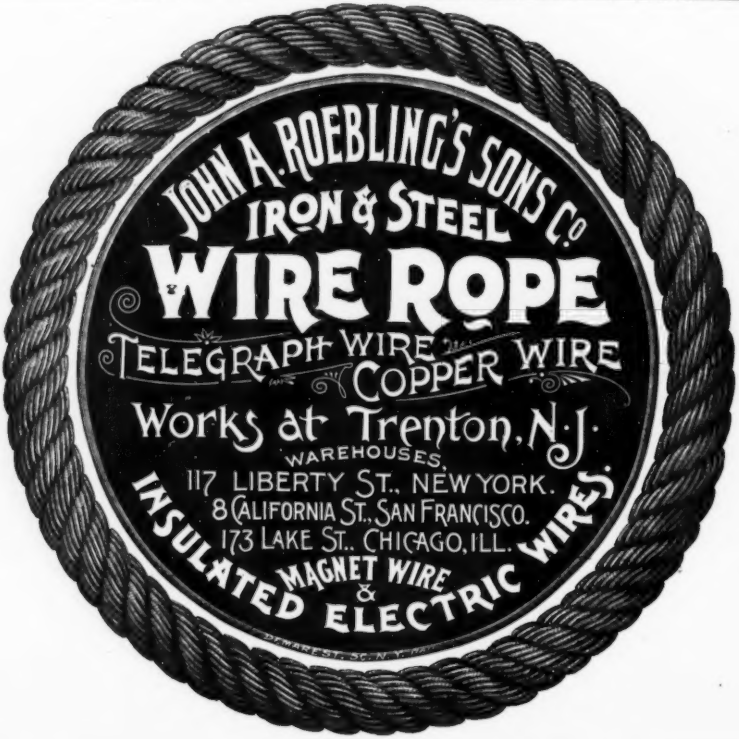

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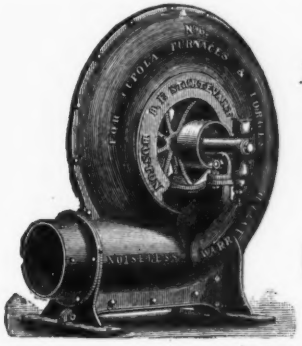

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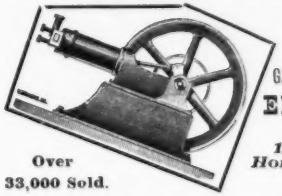

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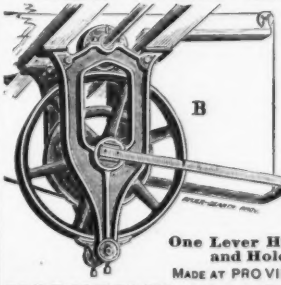

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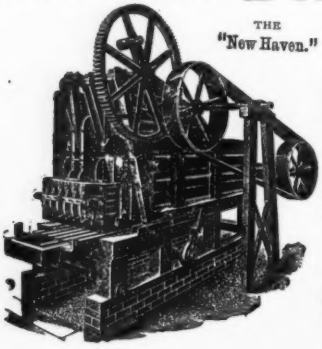

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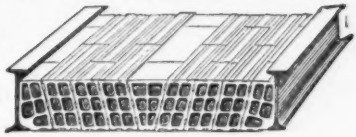

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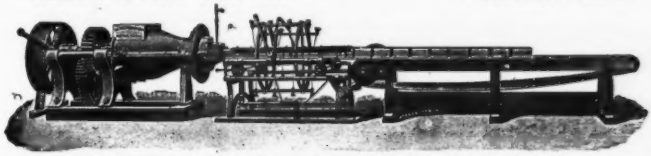

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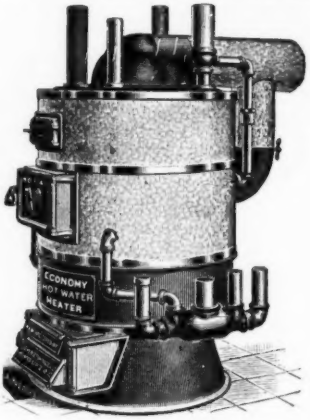

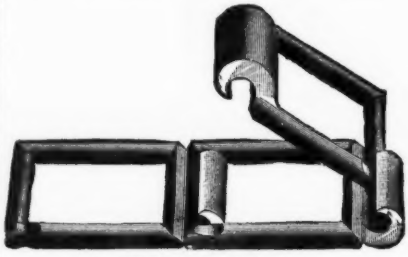

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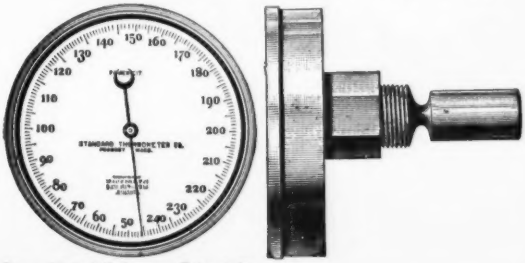

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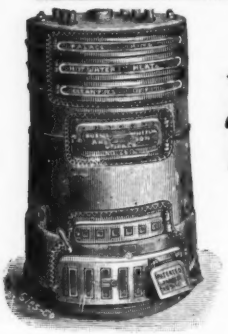

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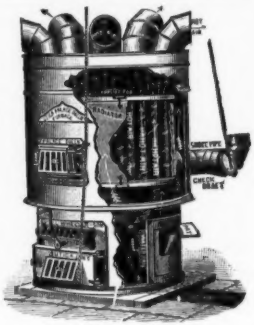

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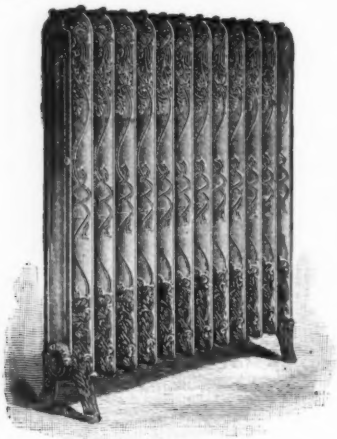

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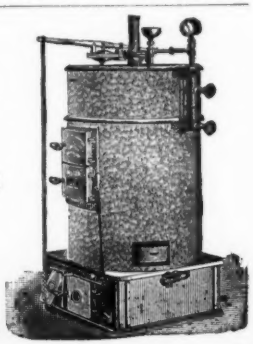

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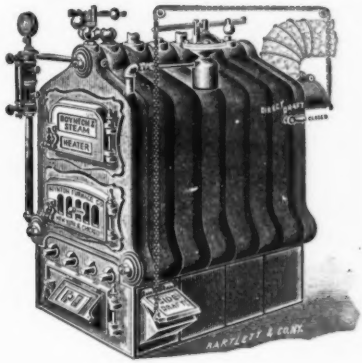

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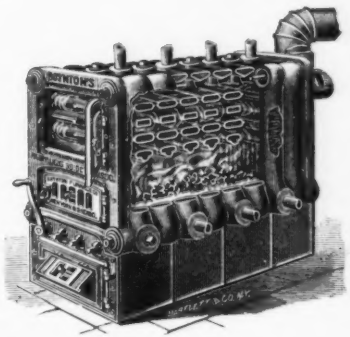

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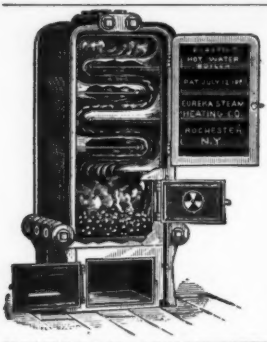

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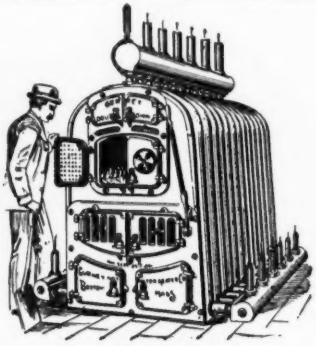

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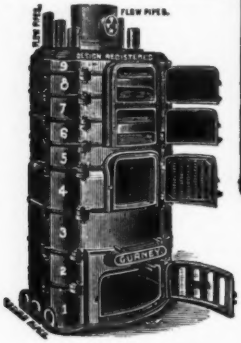

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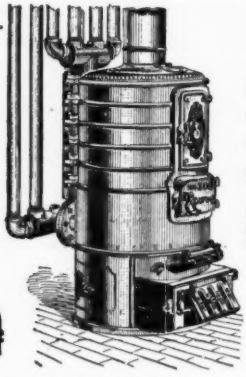

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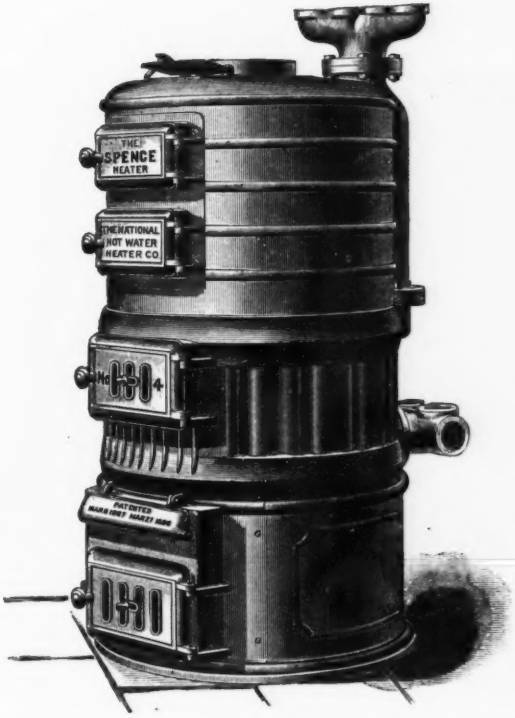

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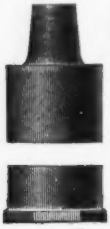

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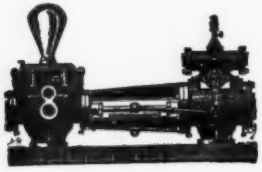

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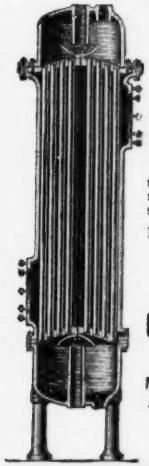

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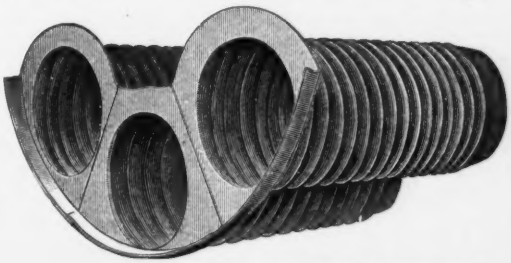

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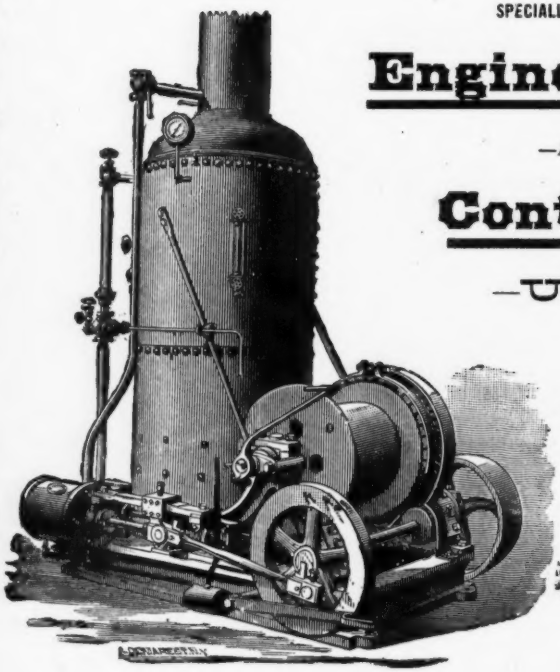

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